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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to assure publication in that week's issue.

WIRELESS TELEGRAPHY IN THE WAR GAME.

During the manœuvres recently carried on by the fleets of the United States Navy, the wireless telegraph apparatus on several of the ships of the "defending" squadron gave a good practical illustration of its utility. One of the best features of this method of communicating at sea is its independence of fog or darkness. As to the matter of secrecy the same conditions are entailed, and with any form of signaling secrecy is only relative and depends entirely upon the knowledge which the enemy has of the code used. The "wig-wag" with flags by day and lights by night can be interpreted only when the code is understood. Why should the wireless message be less safe from intentional interception?

SPEED AND PUBLIC SAFETY.

On another page of this issue will be found a contribution from the pen of Dr. Louis Bell, which discusses the various phases of the problems presented by the speed of mechanically driven vehicles on public streets and highways.

Cause of Many Accidents.

Dr. Bell first takes up the prevalence of accidents which he believes are due to several causes, but particularly to the ignorance or recklessness of the man in charge of the vehicle. The motorman of an electric car seldom realizes the length of the danger space in front of his car and is prone to lay the blame for an accident on his brake, although it may have been in good condition and have done all that could be expected of it. Another point is that the motorman does not always realize how fast his car is going. The tendency is to build larger and heavier cars, and to equip them with motors having a high rate of acceleration. The heavy car gets under way quickly and before the motorman realizes it there is a danger space ahead of him of a couple of hundred feet. It is also true that pedestrians and drivers of other vehicles do not realize the length of the danger space and are apt, for this reason, to take risks which are greater than they imagine, and to throw the responsibility for avoiding an accident upon the motorman, who may be utterly unable to prevent it.

Precaution on Interurban Roads.

Danger of accidents from high speed on public roads can be and is being decreased by running these over private rights of ways and equipping them with reliable power brakes. The tendency on these roads is toward steam railroad practice and it would be well if every one would realize that such roads should be really classed as railroads and not as tramways, and the corresponding precautions necessary to avoid accidents should be taken both by the company and those who find it necessary to cross such roads.

Restraining Reckless Automobile Running.

The problem presented by the automobile is more difficult, because, although the automobile has a greater brake capacity than the electric car and it is also able to turn out of the way and thus may avoid a collision, the speed capacity is generally higher and the man in charge feels greater freedom to run at a high speed and to take chances than does the motorman. However, accidents due to automobiles are brought about by a limited number of reckless men who show little or no feeling for the rights of others. Dr. Bell does not think that accidents caused by this class of men can be decreased by stringent speed regulations. It is difficult to obtain satisfactory evidence and bring the offenders to book in this way, and such regulations can not but be oppressive to those who operate their machines with due respect of the rights of others. The remedy suggested will doubtless meet with much opposition, though it would certainly be effective. It is to forbid the use on public highways of motor vehicles capable of operating on level ground above a certain speed.

Evil of Insuring Automobilists.

Another phase of this question touched upon is the practice of casualty companies of insuring automobilists against accidents. Dr. Bell states this "comes as near to putting a premium on criminal carelessness as anything well can." The remedy suggested for this evil is to make a special criminal law to cover injuries inflicted by vehicles of all sorts due to carelessness of the driver, or of his employer if, at the time of accident, he be part occupant of the vehicle.

ELECTRICAL POWER FOR FARMING WORK.

A field in which the application of electricity seems to be making slow progress is in farm work. There is on all but the smallest farms a good deal of work which might be done more economically by some form of power other than that due to turning a crank by hand or the slow movements of horse or ox. These sources of power are not only expensive, but they are too slow, and the question may be fairly raised why has not some other method found more general use on the farm?

Reasons for Tardy Application of Mechanical Power.

At this time a number of reasons may be given in explanation of this tardiness, though some of these are not likely to prevail for many years longer. In the first place on the average farm there is ample time for the work which must be done, except during two or three short seasons of the year, and any machinery installed with a view to handling especially the work of the busy season would stand idle for a large part of the time during the dull seasons. Again, and this is a serious obstacle, machinery suitable for stationary work—that is, work about the house and barns—is generally not suitable for work in the field; while the mechanical apparatus so far developed for plowing and cultivating is cumbersome and expensive, and although the driving motor of this apparatus could be used for power purpose at other times, this part of the apparatus usually forms a minor part of the whole apparatus, and the greater part would be idle.

Other Difficulties.

Another reason which should be considered is the investment required, as this would be more than the average farmer can afford to tie up in machinery. Another difficulty lies in the distance from the farm to the power station, as the latter is usually located in a village or town and not in a position or of a design suitable for distributing power in small quantities over a large district. These difficulties, while serious for the small farmer, do not hold with the same force for the manager of a large tract of land, to cultivate which recourse must be had to all mechanical aids, and the investment thus made represents but a small part of the total. Steam power is now used frequently on the large farms in the West, where the press of work is so great at times that every means must be taken to get it done as quickly as possible. On these farms, so far as we are aware, electricity is being used only in a secondary way for lighting and for light work, such as pumping and driving small machines around the barn. It has, however, been tried both in this country and abroad for work in the field and with reported success, so far at least as the cost of operation is considered as a criterion.

Weight of Machinery a Drawback.

One difficulty in adapting the electromotor to cultivating ground lies in the fact that motor-drawn vehicles are invariably heavy, and in this character of work they are called upon to travel over very difficult grounds. This difficulty becomes less serious for large fields, because the machine can be made more powerful without increasing its weight proportionally, and in this way more ground can be worked during each journey than would be practicable for smaller fields; as in the latter case the increased cost of the larger would be a serious objection and because there is comparatively little work for it to do.

Minimizing the Difficulty of Weight.

The troubles brought about by the weight of the machine may be overcome more or less, by not running it over the fields but by using it to draw a rope, which in turn draws the plow. This scheme, however, seems clumsy and adds to the equipment required on the machine. It is reported, however, to have given satisfactory results on a number of estates abroad.

Relative Value of Electricity and Steam.

An electrical apparatus for this purpose has some advantages over gas or gasoline, but it has serious disadvantages. Its travel in the field is limited by the length of cable connecting it to the power circuit, and for the same reason the machine can not be used to haul freight, so that the farms supplied with an apparatus of this kind must, nevertheless, retain horses for hauling. The storage battery is, of course, out of the question as yet for apparatus of this kind.

The Trackless Trolley and Farming.

It might seem, therefore, that there is but little prospects of a more general use of electricity for cultivating farms, and it is probable that this condition will prevail for some years to come. But there is one line of development which may take place, and which would seem likely to stimulate the use of electricity for the farm. This development is what has been called the "trackless trolley," that is, an electrically equipped vehicle which runs along an ordinary road where power is supplied by means of trolleys and two overhead circuits. When all turnpikes are supplied with these trolley wires so that vehicles of this kind can travel everywhere, will not those who will then cultivate the soil be only too glad to avail themselves of this cheap and reliable power? One well equipped vehicle will be able to do all the farm work and do the work about buildings, and do all the hauling, and if the machine is well built it could be kept at work all day, and if necessary all night.

Influence of Machinery on Farm.

Conditions at present then seem to be this, it is asserted by those who have had experience that electrical power is cheaper than horse power for farm work, but unless the electric motor can do all the work which is now done by the horse there is little hope of its coming into general use. If, however, the trackless trolley system is developed to any extent, then there is a strong probability that the electric motor will begin to displace the horse on the farm, just as at present it has displaced him for railway work and promises to displace him for all city hauling. And should this come about would it not be another factor to attract men from the city to the country? When all farm work is done by machinery will it not attract men who now look upon it as drudgery of the worst kind?

SPEED AND PUBLIC SAFETY.

THE PREVALENCE OF SERIOUS MISHAP—THE GREATER OPPORTUNITIES FOR ACCIDENT WITH HEAVIER AND FASTER VEHICLES—THE OPERATOR'S INTELLIGENT UNDERSTANDING OF THE DANGER SPACE AHEAD AND THE ULTIMATE POSSIBILITY OF CONTROL—THE ADDED RESPONSIBILITY OF THE PUBLIC—HIGH SPEED WITH SKILFUL HANDLING COMPARATIVELY SAFE—THE REGULATION OF RECKLESS DRIVING SHOULD NOT BE SUCH AS TO ELIMINATE ALL CONVENIENCE TO THOSE WHO OBEY THE LAW.

BY DR. LOUIS BELL.

The last few years have seen a very large increase in the number of fast and heavy motor-driven vehicles used in one way or another on the public roads, and the result has been so ghastly a muster-roll of accidents that public safety demands a grave consideration of the problems that have arisen. In the list of offenders must be joined in evil notoriety both recklessly driven automobiles and recklessly driven electric cars. One can hardly pick up a morning paper without finding fatalities due to both causes and the frequency of these accidents appears to be on the increase even in proportion to the number of vehicles in service. Accidents from vehicles and from street cars have never been rare of late years, but the present epidemic of negligence demands and will receive drastic treatment if it continues much longer.

Neither the electric car nor the automobile is necessarily a menace to safety on the public street, but both may become so when carelessly managed, and in point of fact both must be so classed in numerous instances. The cause of the recent gruesome list of accidents is not to be sought in the increased speeds alone, nor in a marked increase of personal carelessness, but in the combination of high speed, involving new conditions of control, with lack of proper skill or care on the part of the operators. As has often been pointed out the fast driving tough in a buggy has been responsible for many accidents and has often exceeded the legal rate of speed, but the same chap in a forty-mile-an-hour "Red Devil" has vastly greater opportunities in both directions and has improved them with an assiduity worthy of a better object. Moreover, his new resource has very largely increased the proportion of killed among his victims. The electric car likewise has, in careless hands or through various chances for which the motorman may or may not be responsible, a long list of accidents to its discredit as the horse car had before it, but the ordinary tram car is one thing and the fast interurban car is quite another when it comes to the question of adequate control. The result is painfully manifest in increased frequency and severity of collisions, and the present summer has started out as a record breaker in this particular.

These accidents, if accidents they can be called when reckless operation is the cause, occur in spite of undeniably better safety precautions than in the past, and an enquiry into their cause and into possible remedies is certainly pertinent.

The ostensible causes are very various, but when gone carefully over and classified they simmer down to one exceedingly simple proposition, *viz.*, the car was not under the control that its speed and the proximity of possible obstacles demanded. The actual cause of this lack of control may be various; in rare—very rare—instances the brakes fail through a definite fault; more commonly they fail because they have not been properly tested and inspected; the motorman may have been coasting recklessly or may have been racing up to a blind curve in the opinion that nothing could be beyond it. In the writer's opinion, however, these collisions occur generally not through sheer carelessness in inspecting or operating the equipment, but through perhaps equally culpable ignorance as to the real meaning of proper control. Most fast interurban cars are kept in first-class operating order, supplied with good brakes and manned by sober and intelligent crews, who would not wittingly take what they believed to be long chances.

But not one motorman in twenty fully realizes the length of the dangerous space in front of his car or knows from experience what actual space is required for stopping the car at the various speeds at which he is wonted to run. Until this knowledge is generally disseminated and acted upon the present epidemic of collisions will continue. The dangerous space of a car is the distance required at any speed for stopping after the brakes are set. This distance obviously increases with the speed and weight of the car and with any unfavorable condition of the track, and it is mainly the increased speed and weight that are responsible for the added dangers that have come with modern fast interurban cars. The actual length of the dangerous space under service conditions is so much greater than is popularly supposed that collisions can and do occur when the motormen believe themselves entirely safe. After the wreck there is a complaint that the brakes did not hold, whereas the fact is that they did hold all that could reasonably be expected, but were simply incapable of the task set before them.

In an Institute paper read last year by Mr. J. D. Keiley may be found a valuable summary of results in braking modern electric cars that ought to be read by every street railway man in the country from the presidents down to the motormen. The experiments related to a modern car weighing about eighteen tons and fitted successively with various brakes, the operating speeds being about twelve to eighteen miles per hour. At the latter speed the space required for stopping varied from 101 feet with the best attainable power brake to 205 feet with a first-class hand brake worked for all it was worth. The track was in good condition, the brakes were in perfect order and the stops were emergency stops, using all the pressure possible without skidding. Adding to these distances fifty per cent to make safe allowance for unfavorable conditions of track or apparatus, and it at once becomes evident that to take an average car at this speed the dangerous space ranges from about fifty yards to over 100 yards; the former with power brakes, the latter with hand brakes. And it should be added that under these conditions the average power brake would show a dangerous space nearer seventy-five yards than fifty. These are actual experimental results not likely to be bettered appreciably. At higher speeds, which are often reached on interurban lines, the dangerous space is likely to be 100 yards or more.

Now the application of these figures is obvious. If on an interurban line running such cars on a single track, an approaching car looms up through the fog or around a curve a couple of hundred feet ahead, a collision is practically inevitable, and unless the motormen act with great promptness and judgment it is likely to be a serious one. It is useless to charge up such an occurrence to the brakes being out of order, for they are simply incapable of doing the work set for them. The only way to safety, aside from an absolute block system, which is very hard to apply to a long interurban line, is reducing the speed at all points and times when there is not clear and visible track ahead to the extent of double the danger space. On double-track roads and as respects other vehicles the full danger space of clear track will ensure safety. Unless such an allowance of space is made the

car is not under control for the purposes of public safety, and should be considered as running negligently. Once the idea of dangerous space is fully grasped the avoidance of collisions and other accidents becomes relatively simple. No one blames a motorman who runs with due caution and keeps his car under proper control, but in order to do this he must understand what it means. On the other hand, the public is not without its increased responsibilities. It should understand that what was ample leeway in crossing a car track ten years ago is to-day taking desperate chances, and should govern itself accordingly. A car running at even fifteen miles per hour covers twenty-two feet per second, and is likely to require nearly forty yards for a stop. Increased speed has come as the result of a general demand, and is an important factor in the comfort of urban life. The real question is the safe limit of speed when the cars share the roadway with other vehicles. Questions of right of way are comparatively simple, because the electric car is confined to a track that all may see and avoid. And as to the actual speed permissible, it is likely with present conditions that the common limit of fifteen miles per hour on public roads is not far from right. That is, any considerable increase above that maximum is likely to involve considerable added danger. But whatever the nominal limit of speed the important thing is that the motorman should know his dangerous space and keep his car under control accordingly. Demands for high speed will resolve themselves into practically requiring a separate right of way, already common on fast interurban lines.

Speed questions concerning the automobile are very much more troublesome. The automobile has far less dangerous space, based on braking capacity, than the electric car, and it also can readily turn out for other vehicles. On the other hand, it has generally far greater capacity for speed and is run at higher speed in far more dangerous circumstances. The writer firmly believes that the automobile has come to stay and that it should be fairly treated and given reasonable encouragement. Nevertheless, it is only too obvious that it is often operated so recklessly that it is a grave menace to other occupants of the highways. A legal speed limit is fixed for automobiles, but everybody knows that most such vehicles are deliberately intended for far higher speeds and run above the legal limit customarily and intentionally. Furthermore, in careful hands they can do this safely and without inconvenience to anybody. A skilfully handled machine at twenty or twenty-five miles an hour is far less dangerous than one in reckless hands at half such speed, but unhappily the careful handling is frequently at the lower speed and the criminal recklessness at the higher.

The whole question of safe automobile speeds resolves itself into eliminating the person who drives his auto or causes it to be driven with impudent and brutal disregard of the rights of other travelers. The occupant of the Red Devil has just as much and no more privilege on the highway than Weary Raggles plodding along toward the next township. As a class, Mr. Raggles has far more rights, for he can outvote his more speedy fellow traveler ten to one. It is altogether impudent for the latter to bluster and demand the right to butt the former into the ditch. In solemn fact, the entire contingent who owns or habitually rides in automobiles is and will be for a long time to come so minute a fraction of the population that its collective rights are utterly inconsequential in the public welfare. And of this small fraction only a small number have to be considered in relation to speed. Nine automobilists out of ten intend to be law-abiding, to pay due regard to the rights of their fellows, and to behave in all respects like the decent citizens that they are. It is the tenth man who blatantly denounces all regulations as outrageous, runs at full speed through crowded streets, laughs and puts on more speed when a horse bolts, and skips the town when he runs down a pedestrian. In point of fact, he has no more "right" to careen through the highways than he would have to insist on rifle shooting in the public parks.

And the task before the community is to restrain this tenth man without needlessly inconveniencing the other nine. Speed limits, as at present administered, are utterly farcical. If low enough to remove the real and serious danger it is so low as to rob the automobile of the properties that will ultimately render it most valuable. As generally constituted, the limits are so low that they are frequently passed in complete innocence, and the usual plan of police traps to catch the offenders generally gets the wrong men. No speed limit can be properly enforced as generally managed, since no man without using a stop watch can definitely state whether the speed was a quarter mile above or below the limit.

There is just one way in which a speed limit can be enforced—by absolutely forbidding the use on public highways of motor vehicles capable of operating above the limit on level ground, under penalty of permanent forfeiture of license and fine if necessary. The maximum speed of a vehicle can be tested before licensing, and reexamined if there is reason to suspect fraud. This would be drastic but effective, and it is "up to" the law-abiding majority of automobilists to see that it is made unnecessary.

It is utterly silly to prate about the spirit of the times demanding more liberal speeds, and to cite electric cars as justification. The fast automobile is not a common carrier nor a public convenience. It is and is likely to remain a private vehicle used for pleasure by a few tenths of a per cent of the population. The automobile as a practical working vehicle for ordinary purposes will involve no serious speed questions. A speed limit of fifteen miles an hour, enforced, as just noted, would probably be actually a good thing for the progress of the art, tending to the development of useful vehicles capable of running long distances under load, and eliminating most of the objectionable characters who would abandon the sport if kept to moderate speed.

From the standpoint of public safety, one of the most serious matters is the insuring of automobilists by casualty companies against damages resulting from killing or injuring their fellow travelers. If this practice continues the risks even at moderate speeds will be greatly increased. It comes as near to putting a premium on criminal carelessness as anything well can. The only proper rejoinder is to make a special criminal statute to cover injuries inflicted by vehicles of all sorts due to carelessness of the driver or his master if a cooccupant of the vehicle. A moderate term in the penitentiary for a few offenders would settle the present difficulties more speedily than anything else, and the average jury can be trusted to convict the criminally reckless and release the innocent. Fines are worse than useless against the offenders, particularly if insured, but imprisonment would not be a nice thing to contemplate. A proper statute of this sort would render a speed limit almost needless, or at least would allow a much higher limit than at present without increasing the danger of accidents. Finally, there ought to be a statute settling a proper rule of the road for vehicles of various sorts, based on the same sort of common-sense requirements as the marine rules in universal use. Our present rules fail in not including the contingencies arising from enormous differences of speed, weight and general managing ability. The automobile is a menace to safety only when recklessly used and regulations concerning it should be aimed at recklessness, and not made to inflict petty annoyances on the law-abiding.

Preliminary Report of the Electric Light and Power Plants of the United States for the Year Ending June 30, 1902.

The following report has been received from the United States Census Office, Division of Manufacturers:

DEPARTMENT OF COMMERCE AND LABOR,
BUREAU OF THE CENSUS.

WASHINGTON, D. C., August 3, 1903.

HON. S. N. D. NORTH,
Director of the Census.

SIR—I have the honor to make the following preliminary report on the electric light and power plants of the United States for the year ending June 30, 1902.

CENTRAL ELECTRIC LIGHT AND POWER PLANTS.

	Total.	Private.	Municipal.
Number of establishments	3,619	2,804	815
Cost of plants	$502,181,511	$480,161,088	$22,020,473
EARNINGS FROM OPERATION.			
Total	93,585,410	76,748,554	6,836,856
From light service	69,731,931	62,983,068	6,748,863
Arc lighting	25,459,437	22,070,192	3,389,245
Commercial or private	8,443,280	8,203,114	240,166
Public	17,016,157	13,867,078	3,149,079
Incandescent lighting	44,272,494	40,912,876	3,359,618
Commercial or private	41,536,392	38,668,096	2,868,296
Public	2,736,102	2,244,780	491,322
All other electrical service	13,853,479	13,765,486	87,993
Income from all other service	1,560,013	1,431,764	128,249
Gross income	85,145 423	78,180,318	6,965,105
EXPENSES.			
Total	67,688,075	62,442,088	5,245,987
Salaries and wages	20,551,989	18,672,267	1,879 722
Supplies and materials	22,814,758	20,392,467	2,422,291
Rent of stations and offices	1,285,546	1,270,798	14,748
Taxes	2,654 065	2 643,945	10,120
Insurance	886,445	820,804	65,641
Miscellaneous	6,994,227	6,645,567	348,660
Interest on bonds	12,501,045	11,996,240	504,805
POWER-PLANT EQUIPMENT.			
Steam engines.			
Number	5.921	4,861	1,060
Horse-power	1,377,041	1,230,023	147,018
Water-wheels.			
Number	1.378	1,296	82
Horse-power	381,134	369,916	11,218
(1) Estimated value if paid for at prevailing rates.			
GENERATING PLANT.			
Dynamos.			
Direct-current, constant voltage	3,820	3,402	418
Number	.....	.....	.....
Horse-power	441,621	418,088	23,534
Direct-current, constant amperage	3,537	2,955	582
Number	.....	.....	.....
Horse-power	195,431	157,668	37,763
Alternating and polyphase current	5,106	4,284	822
Number	978,428	887,740	90,688
Horse-power	.....	.....	.....
OUTPUT OF STATION.			
Kilowatt-hours, total for year	2,437,218,732	2,241,314,293	195,904,439
LINE CONSTRUCTION.			
Miles of mains and feeders	12,470,494	10,936,603	1,533,891
LIGHTING SERVICE.			
Arc lamps.			
Total number	385,208	334,413	50,795
Commercial or private	173 502	167,709	5,793
Public	211,706	166,704	45,002
Incandescent lamps.			
Total number	18,006,521	16,429,060	1,577,461
Commercial or private	17,552,756	16,058,111	1,494,645
Public	453,765	370,949	82,816
AVERAGE NUMBER OF EMPLOYES AND TOTAL SALARIES AND WAGES.			
Salaried officials and clerks	6,976	6,026	950
Salaries	$5,632,880	$5,175,499	$457,381
Wage earners	23,258	20,791	2,467
Wages	$14,919,109	$13,496.768	$1,422,341
Foreman and inspectors	1,560	1,478	82
Wages	$1,358,272	$1.297,585	$60,687
Engineers and firemen	8 020	6,671	1,349
Wages	$5,201,988	$4,416,929	$785,059
Linemen	4,209	3,860	349
Wages	$2,704,529	$2,503,957	$200,572
All other employés	9,469	8,782	687
Wages	$5,654,320	$5,278,297	$376,023

This report includes central stations only. It does not include isolated plants, plants operated by electric railway companies or plants that were idle or in course of construction.

The final report will contain an analysis of the above totals and present detailed statistics by states and for other phases of the industry. The statistics for this industry at the census of 1890 were confined to the state of New York, the city of St. Louis, and the District of Columbia, therefore no comparison can be made with the totals for the United States.

Very respectfully,

W. M. STEWART,
Chief Statistician for Manufacturers.

Approved:

S. N. D. NORTH,
Director.

Position and Protection of the Third Rail on Electric Railways.

At the recent engineering conference held in London, a paper was read by Mr. William E. Langdon on the "Position and Protection of the Third Rail on Electric Railways." By the third rail is here meant the rail carrying the current to the motors, and it is pointed out that there is a tendency now to add a fourth or return rail in order to avoid the use of the track rails as conductors. The author thought that the time had now arrived when surface lines of railway and lines of ordinary construction for steam haulage have to be considered in relation to their operation by electricity. It was very important that some decision should be reached as to the position of the conductor rail. In England there appears to be no uniformity in practice, but this may be accounted for by the fact that there electrically driven railways have been mainly confined to underground routes.

While there is no absolute necessity for protecting the return rail, for the third or conducting rail protection is desirable and has in some cases been provided. This protection consists generally of a vertically arranged plank on one or both sides of the rail, but this affords no protection from weather and but an imperfect protection against accidental contact. As climatic conditions will be found to give more trouble than accidents, it would appear desirable that the most complete protection should be provided for. A cover should be installed, extending so far beyond a vertical line drawn from the edge of the rail as would prevent a person standing against it or an implement placed against it from touching the conductor. The two important questions presented were, first, the distance which should supervene between the near wheel rail and the conductor, and, second, whether the sleepers which carry the wheel rails should be used for the conductor rails. It is probable that the first of these questions will be determined only after experience of the climatic effects.

In respect to the second question, it should be borne in mind that the permanent way must be constantly patrolled and that packing and drainage of the sleepers are essentially an every-day occurrence, that renewals of sleepers and rails, etc., must be provided for, that when laying out stores for any of these works the outside of the line is almost invariably used, and that this side is also used by persons walking the line. These conditions, it is thought, suggest the propriety of confining the conductor rails to the space between the tracks and dissociating them entirely from the sleepers which carry the wheel rails.

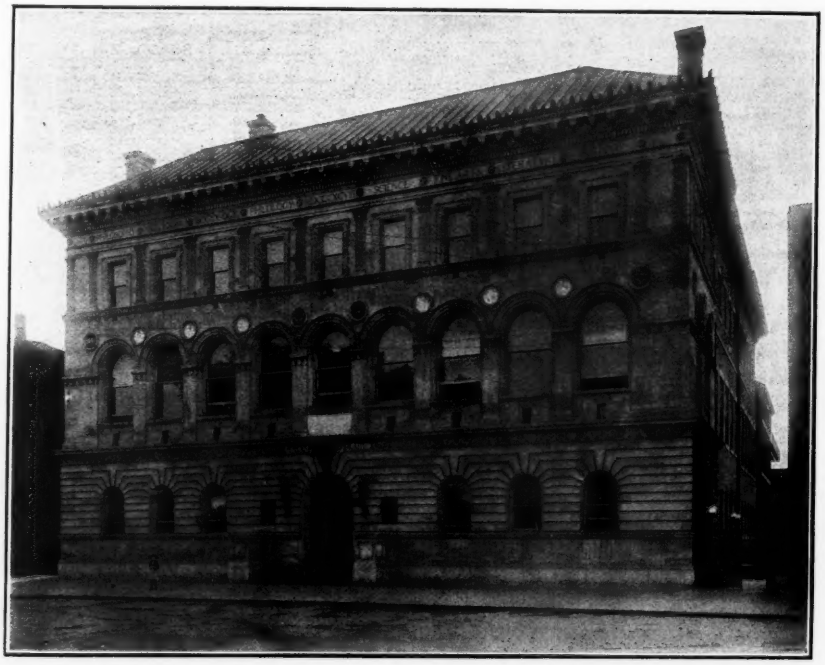
Where a fourth rail is used, this would necessitate the provision within the same space for the return rail, but these might be placed upon the same structure as the conductor rails. This would be more complicated than placing the return rail between the track rails, but it would be more convenient for repairs to have both rails placed between the two tracks. With the rails between the tracks, some special construction would be necessary to maintain the conductor at crossings when locomotives are used, but with multiple unit trains there would be no necessity for this.

Mechanical Plant in the Newark, N. J., Free Public Library.

The buildings of the Free Public Library of Newark, N. J., are located on Washington street, near the intersection of Broad street, and occupy a site about 102 by 220 feet in extreme dimensions. The main building is four stories in height and 102 by 137 feet in area, and is constructed mainly of brick, but faced on the front and part of the sides with Indiana limestone appropriately carved with figures and names prominent in art, literature and bookmaking. The interior is more strikingly beautiful and resembles an arrangement and style now common in public and municipal buildings. The entrance vestibule at the centre of the front is executed in white Italian marble and mosaic and the central rectangular corridor into which it leads has a wainscoting of marble and a plaster frieze and ceiling decorated in color. Through the centre the corridor is open to the skylight roof, leaving hallways at each floor in the form of arcades surrounding the courtlike centre space. From floor to floor these are reached by two bronze-railed marble stairways at each side, except from the first to the second floor, where they are replaced by a single broad staircase entirely of marble rising through the middle of the corridor with its base directly in front of the main entrance and its head at the entrance of the library delivery room on the second floor. The first floor accommodates the children's library, newspaper room, toilets and janitor's room. The main features of the second floor are the delivery room, just mentioned, and a large reading room, both handsomely furnished and finished in dark oak. The third floor contains a trustees' room and a librarian's room, and the fourth floor, a lecture room and art gallery. The book stacks are in a practically detached fireproof building, which stands near one corner of the rear of the main building and is connected with it only by passageways, so that it was possible to have windows on all sides of both structures.

The buildings are lighted by direct-current arc and incandescent lamps and heated with exhaust steam by indirect radiation in connection with a plenum system of ventilation, and supplementary direct and direct-indirect radiation in the most isolated locations. A passenger elevator, five book-lifts, a plenum fan and three exhaust fans, all motor-driven, constitute the power load. The mechanical plant, including boiler and engine rooms, occupies a third separate building, located at the other rear corner of the main building, on a level with and adjoining the basement through which the pipe, duct and wire runs are carried. The boiler room is thirty-four feet long by twenty-four feet wide and is situated under the rear courtyard, so that coal may be brought in from the street and dumped through chutes to the storage bins, which are at one side of the room facing the boilers with a six-foot firing floor between. The steam-generating equipment comprises two 100-horse-power return tubular boilers set side by side with space left for a third. They were furnished by the Erie City Iron Works, are five and one-half feet in diameter by sixteen feet long, and contain five and one-half by six-foot grates. The boiler settings are arranged with firebrick flues above so as to cause the gases of combustion to pass back over the shell after passing through the tubes before being finally discharged through the brick smoke header. The latter contains a damper automatically controlled by a Kieley regulator to maintain the desired steam pressure, and connects to a rectangular brick chimney seventy-four and one-half feet high and three and one-half feet square on the inside. From a dry pipe in each boiler connection is made by a six-inch copper bend to a ten-inch steam header, which, pitching slightly downward, passes through the dividing wall into the adjoining engine room, where it terminates in a down-curving elbow, the bottom being closed with a blank flange and dripped to a steam trap. A seven-inch pipe is taken from the upper side of the main near the end to a point overhead between the engines, where through an inverted Y it divides into two five-inch pipes to supply each of the two engines.

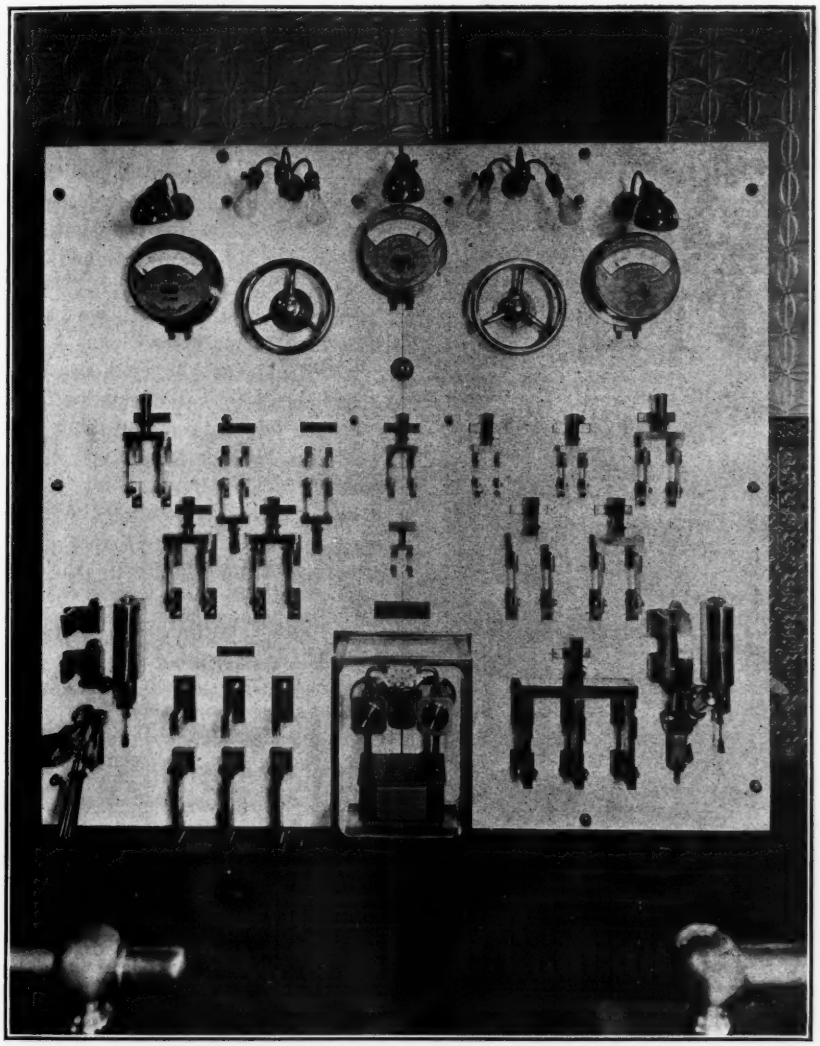
The engines are Watts-Campbell Corliss-type, sixteen by thirty-inch horizontal side-crank, extra heavy engines, and drive two Crocker-Wheeler 100-kilowatt, direct-current, eight-pole generators by direct-connection at 120 revolutions per minute. When admitting steam at an initial pressure of eighty-five pounds, cutting off at one-quarter stroke and exhausting with a back pressure of five pounds per square inch, the engines are capable of developing 136 indicated horse-power. Speed regulation is obtained in the usual manner by altering the point of cutoff through the agency of a flyball governor and mechanism, but to avoid accident, should this one fail to work, a second governor is provided and so set that an increase in speed of ten revolutions per minute will cause the closing of a butterfly valve, cutting off the steam supply. The flywheels are ten feet in diameter, weigh 20,000 pounds and are placed between the cranks and generators.



THE NEWARK, N. J., PUBLIC LIBRARY.

The generators were designed for a normal load of 800 amperes at 125 volts and a safe momentary overload of forty per cent, but have proved capable of carrying even more, and for a considerable length of time. On one occasion, while only one set was running, the load was gradually increased until at 1,130 amperes, or 41 per cent overload, the engine reached its

limit of power and refused to cut off. It is reported that throughout the test there was no noticeable sparking at the commutator and that at the close of it the field coils were only about thirty degrees and the brushes seven degrees warmer than the surrounding air. A total of some 2,500 sixteen-candle-power lamps constitutes the lighting load and, as previously stated, the power load includes four motors in connection with the ventilation system, five motors for book-lifts and one motor for the passenger elevator.



SWITCHBOARD, NEWARK, N. J., FREE PUBLIC LIBRARY.

Live steam from the large main is also used to supply two boiler feed pumps, a sump pump and the heating system through a pressure-reducing valve when the exhaust steam is insufficient. The pumps are located in the engine room near the boiler-room door. Those used for feeding the boilers are six by four by six-inch Barr duplex pumps, cross-connected so that they may be used interchangeably. The other is a four by four by five-inch single-acting pump, used to drain the blow-off tank to the sewer. The tank is five feet in diameter and twelve feet long and located under the coal vault.

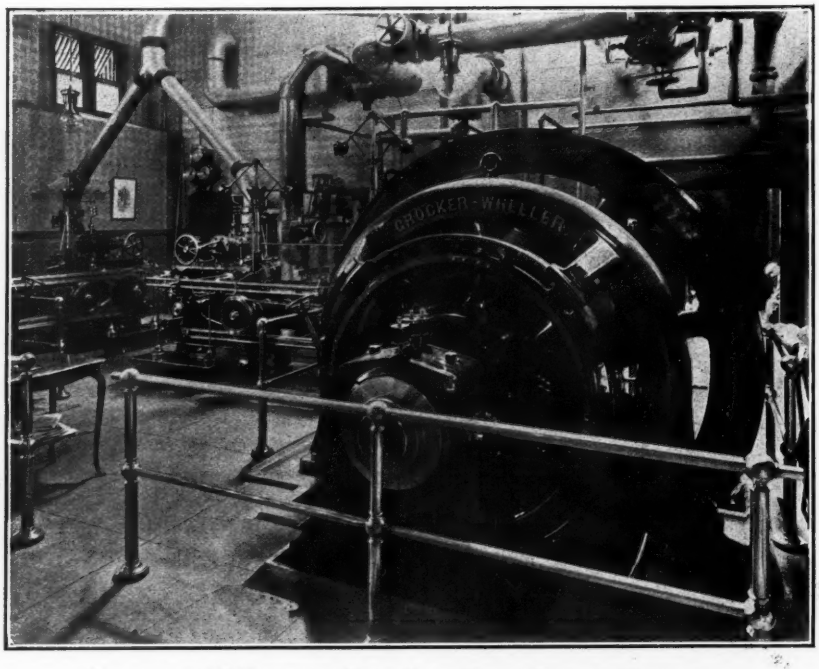
The eight-inch exhaust connections from the engines are laid in trenches under the floor and combine with the pump exhaust into a twelve-inch overhead main, containing a grease extractor. In its cleaned state part of the steam is taken through a six-inch branch to a Webster 100-horse-power, open feed-water heater, another part through a ten-inch branch to the heating system, while the remainder, if any, escapes to the atmosphere through a ten-inch riser, after passing a back-pressure valve set at about two or three pounds. The connection to the heating system is made at a cross, one arm receiving the eight-inch live steam connection and the other two, six and eight inches, respectively, delivering into the heating mains, the former for the tempering coils in the intake of the air for ventilating and the book-stack building, and the latter for the main building.

The condensation from the heating system is collected in a six-inch main and returns by gravity over a loop-seal four feet high into the feed-water heater which thus serves the additional function of a receiving-tank. Since the heater is of the open type, it condenses within the feed all exhaust steam used for heating the latter. It is, therefore, evident that the only waste is the amount lost through the exhaust riser. This is compensated for by cold water taken from the city service and automatically admitted by a float governor, so as to maintain a minimum height of water in the heater. A similar governor causes the opening of an overflow valve, allowing the surplus to drain to the sewer if a maximum height is exceeded.

The air circulation for ventilating is established by an eight-foot Seymour disc fan driven by belt at 220 revolutions per minute by a fifteen-horse-power motor and discharging in that time between 63,000 and 65,000 cubic feet of air. The removal of the vitiated air is made positive by the use of three exhaust fans of the Seymour disc type located in the attic. One having a four-foot wheel is driven by a five-horse-power motor, and two having three-foot wheels, by three-horse-power motors. Of the motor-driven book-lifts, three will raise twenty-five pounds at the rate of 150 feet per minute, and the other two will carry 100 pounds 100 feet a minute. All are provided with electric control, whereby the cars may be brought to any floor by pushing the button corresponding thereto, if all of the doors into the shaft are closed. The opening of any one of them breaks the circuit and stops the car. The passenger elevator has a travel of about fifty-two feet and will carry a maximum load of 2,000 pounds at 200 feet per minute, or an average load of 1,200 pounds at 250 feet per minute. In addition to the customary slack-cable safety device and automatic top and bottom stops, the shaft was made tight at the bottom to afford an air cushion to catch the car in case of a failure of the other protections. After its installation the elevator was tested by loading the car with a weight of 2,000 pounds and allowing it to drop from the top of the shaft, which it did without receiving any injury.

The switchboard is about six and one-half feet wide, seven and one-half feet high and consists of two panels of white Italian marble. A single set of bus-bars on the back of the board serves for both light and power service, being connected to each generator through a single-throw, three-pole switch protected by a single-

pole circuit-breaker. The instruments include two ammeters, one for each machine; a voltmeter, which by a multiple-point switch may be connected to either generator, and a recording station wattmeter. The feeder-circuit switches are symmetrically grouped on both panels between the dynamo switches and the indicating meters. Three are for power and the remainder for light. The lighting feeders are supported on porcelain knobs four feet apart and lead from the switchboard to and up the elevator shaft. These include two sets of conductors for the first floor and one set for each of the floors above. From a cutoff box near the shaft at each floor the distributing circuits are taken to the various marble panel-boards, seventeen in all. In determining the sizes of the conductors, the maximum loss of potential allowed between the switchboard and the lamps was five volts; three in the mains, one in the sub-mains and one in the distributing circuits.



One of the 100-Kilowatt, Eight-Pole, Direct-Current Generators, Newark, N. J., Free Public Library.

The architects for the building were Messrs. Rankine & Kellogg, of Philadelphia, and Messrs. Francis Brothers & Jellett, of the same city, prepared the plans and specifications for the heating and steam work. Mr. James M. Seymour, Jr., of Newark, N. J., was the consulting engineer in behalf of the library trustees. The contractors for the various parts of the equipment were as follows: The Philadelphia Steam Heating Company for the heating system and steam pipe work; Messrs. Gillis & Geohegan, of New York, for the fans and tempering coils; the Crocker-Wheeler Company, of Ampere, N. J., for the electric generators; and Messrs. Blake & Williams, New York, for the electric wiring. Mr. George A. Warren is the operating engineer of the plant.

Commercial Vehicle Contest.

The Automobile Club of America has issued the report and awards of the commercial vehicle contest held in New York city, May 20 and 21, 1903. But eleven vehicles started in this contest and seven finished. These vehicles were all commercial machines and were run loaded. The contest lasted two days and was of such a nature as to bring out the features of the long haul as well as the short haul and by enforcing conditions simulating as nearly as possible those of actual delivery and traffic to determine the vehicles best adapted to each variety of haulage. Each machine made forty miles each day. On the first day, no stops were made, except such as the conditions of the traffic made necessary. On the second day, the vehicles made a number of specified stops, varying from five for trucks carrying 20,000 pounds dead load to 100 stops for machines carrying from 750 to 1,500 pounds dead load.

But one electrically driven machine was entered. This was a Waverley delivery wagon constructed by the Pope Motor Car Company, of Toledo, Ohio. The motor equipment consists of two three-horse-power motors, each capable of an overload of an additional three horse-power. The speed could be varied from five to twelve miles per hour. The weight of the truck and equipment was 2,420 and the dead load carried was 1,210 pounds. This machine completed the two days' run. The first day it ran forty miles carrying two passengers and the load. The actual running time was five hours and twenty-nine minutes, making an actual running speed of 7.26 miles per hour. As the machine was sent out not fully charged, it was necessary to make a stop to recharge the batteries. Twenty-four minutes were required to make connections and twenty minutes were spent in charging. There were in addition two minutes used in stops for traffic, making a total of forty-six minutes' stop and an elapsed time of six hours and fifteen minutes.

Before starting, the batteries had been charged with ten kilowatt-hours. During the noon hour, one kilowatt-hour was added and during the stop mentioned above a second kilowatt-hour, making in all twelve kilowatt-hours. At six cents per kilowatt-hour, the total cost for power was seventy-two cents, making the cost of power per ton-mile 0.0296 cent. On the second day, the machine traveled the same distance with the same load in four hours and fifty-three minutes, the actual running speed being 8.19 miles per hour. One hundred specified stops of fifteen seconds each were made and sixteen traffic stops. The total time required for this was twenty-five minutes, making the elapsed time five hours and eighteen minutes. Before starting, the batteries received a charge of ten kilowatt-hours. At the noon hour, two kilowatt-hours were added in forty-five minutes, making twelve kilowatt-hours in all, which gives the same cost per ton-mile as on the first day.

It should be noted that no allowance is made in these estimates for the condition of the battery before and after charging except voltmeter readings. On the first day, the voltage of the batteries fell from eighty volts at thirty-ampere discharge at the start to seventy-five volts at twenty-five-ampere discharge at the end of the run. On the second day, the voltage was eighty volts at a twenty-five-ampere discharge at the start and seventy-nine volts at the same rate of discharge at the end of the run. This vehicle was given the third prize in its class.

The international conference on wireless telegraph assembled in Berlin, Germany, on August 4. Italy was represented by Rear-Admiral Grillo, captain of the gunboat Bonomo, delegated by the Minister of the Marine, and MM. Cardalii, chief of the Department of Posts and Telegraphs, and Solari, lieutenant of the navy, delegated by the Minister of Posts and Telegraphs.

POWER MEASUREMENT ON ALTERNATING-CURRENT CIRCUITS.

BY R. B. WILLIAMSON.

Power measurement on alternating-current circuits, particularly on polyphase circuits, involves the consideration of a number of features not met with in direct-current power measurements. In a direct-current circuit the power in watts is obtained by taking the product of the volts and amperes, but with alternating-current circuits this can not usually be done because of the phase difference which, in most cases, exists between the current and the electromotive force.

In Fig. 1 let the light line wave represent the electromotive force applied to a single-phase circuit or receiving device, and the heavy line wave the current that is set up by the electromotive force. The electromotive force at any instant is equal to the projection of the uniformly revolving line $o\ b$ on the vertical; $o\ b$ is supposed to revolve at the rate of n revolutions per minute in the counter-clockwise direction as indicated by the arrow. In the same way the projection of the line $o\ a$ on the vertical represents the value of the current at any instant. The lengths of $o\ b$ and $o\ a$ are laid off to scale to represent the maximum values of the electromotive force and current respectively. In one second the lines would revolve through an angular distance of $2\ \pi\ n$ radians and t seconds the angular distance moved over would be $2\ \pi\ n\ t$ radians. At the instant represented in Fig. 1 the lines $o\ a$ and $o\ b$ have revolved through the angle $2\ \pi\ n\ t$ where t is the time that has elapsed since the beginning of the cycle or revolution, when $o\ a$ and $o\ b$ coincided with the horizontal. The projection of $o\ a$ on the vertical is equal to $m\ n$, and $m\ n$ therefore represents the value of the current at the instant under consideration; $m\ p$ represents the value of the electromotive force at the same instant. For every complete revolution of $o\ a$ and $o\ b$ the electromotive force and current pass through a complete cycle of instantaneous values as represented by the sine waves and hence the number of revolutions per second n is numerically equal to the frequency of the electromotive force or current. It will be noticed that Fig. 1 is drawn for the case when $o\ a$ and $o\ b$ revolve exactly together and the two curves consequently pass through their maximum values at the same instant and pass through zero at the same instant. The electromotive force and current are in phase—a condition which would exist if the current were flowing in a circuit devoid of inductance or capacity, or in which the inductance and capacity, if present, neutralized each other.

In the case shown in Fig. 1 the current i at any instant is equal to the projection on the vertical or is equal to $\mathsf{I} \sin 2\ \pi\ n\ t$ where I is the maximum value of the current represented by $o\ b$. The electromotive force e at any instant will be $\mathsf{E} \sin 2\ \pi\ n\ t$ where E is the maximum electromotive force. Now the power supplied at any instant is found by multiplying the electromotive force at the instant by the current at the same instant. This is true no matter what phase relation the maximum values of current and electromotive force may have. We have then

instantaneous power $= e\ i = \mathsf{E} \sin 2\ \pi\ n\ t\ .\ \mathsf{I} \sin 2\ \pi\ n\ t = \mathsf{E}\ \mathsf{I} \sin^2 2\ \pi\ n\ t.$

In the great majority of cases the power at any instant is of little concern. What is required is the average power supplied and from the above we have

average power $= e\ i = \mathsf{E}\ \mathsf{I}$ av. $\sin^2 2\ \pi\ n\ t.$

From trigonometry we have $\sin^2 a + \cos^2 a = 1$, where a is any angle, and hence average $\sin^2 a +$ average $\cos^2 a = 1$. But in passing through a set of values say from 0 to 90 degrees, the sine varies from 0 to 1 and the cosine from 1 to 0. Each passes through the same set of values so that the average of the squares of all the values of the sine must be equal to the average of the squares of all the values of the cosine. Consequently we may write av. $\sin^2 a +$ av. $\cos^2 a = 2$ av. $\sin^2 a = 1$, or av. $\sin^2 a = \frac{1}{2}$ and average power $= 2\ \underline{\mathsf{E}}\ \underline{\mathsf{I}}$. Now alternating measuring instruments do not indicate the maximum values E and I of the electromotive force and current. They indicate virtual or effective values which are equal to the square root of the average of the squares of the instantaneous values. We have just seen that the instantaneous value of the electromotive force is

$e = \mathsf{E} \sin^2 \pi\ n\ t$, hence

$e^2 = \mathsf{E}^2 \sin^2 2\ \pi\ n\ t$ and

av. $e^2 = \mathsf{E}^2$ av. $\sin^2 2\ \pi\ n\ t =$

$\frac{\mathsf{E}^2}{2}$ $\sqrt{\text{av. } e^2}$ = effective value, $\mathrm{E} = \frac{\mathsf{E}}{\sqrt{2}}$. Also effective current $\mathrm{I} = \frac{\mathsf{I}}{\sqrt{2}}$.

If we substitute these values of E and I as the expression found above for the power, we have

average power $= 2\ \mathrm{EI} =$

$$2\ .\ \frac{\mathsf{E}}{\sqrt{2}}\ .\ \frac{\mathsf{I}}{\sqrt{2}} = \mathrm{EI}$$

In other words, when the current and electromotive force are in phase the average power, in watts, can be obtained by taking the product of the voltmeter and ammeter readings as with direct current.

In Fig. 1 the ordinates of the dotted curve are proportional to the power at each instant and it will be noted that at all instants the power is positive because the power curve lies wholly above the horizontal axis. This means that, at all instants, power is being supplied to the circuit or receiving device.

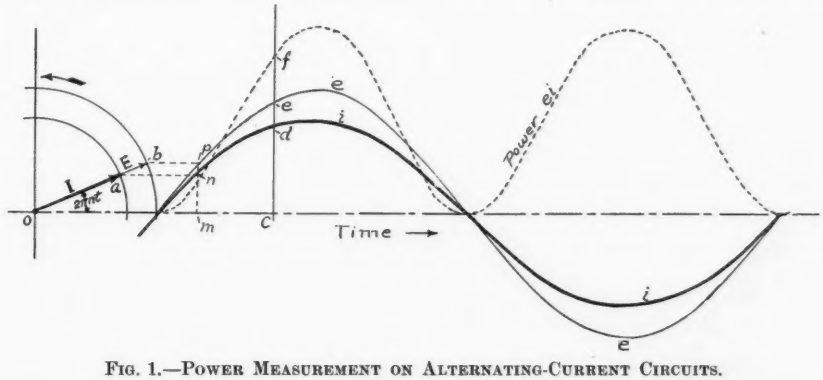


FIG. 1.—POWER MEASUREMENT ON ALTERNATING-CURRENT CIRCUITS.

In most cases the current and electromotive force will not be in phase and the phase difference between them has an important bearing on the amount of power supplied. Suppose the current $o\ a$ lags behind the electromotive force $o\ b$ by the angle ϕ indicated in Fig. 2. The corresponding current and electromotive-force waves are now represented by $i\ i$, $e\ e$ and the ordinates of the dotted wave are, as before, proportional to the product of e and i at each instant. Lines $o\ a$ and $o\ b$ revolve at the uniform rate of n revolutions per second, but $o\ a$ always lags behind $o\ b$ by the fixed angle of lag ϕ. Now, on account of the phase displacement between the current and electromotive-force waves, it is easily seen that at certain instants the current and electromotive force are opposed to each other. For example, at the instant represented by point g, the current $g\ h$ is positive while the electromotive force $g\ l$ is negative. The product of the two, *i. e.*, the

power, is therefore negative. The portions of the power curve represented by the shaded areas are negative, as during these intervals power is being returned by the circuit or receiving device and the actual energy supplied is the difference between the positive and negative areas between the power curve and the horizontal. It is easily seen, then, that when the current and electromotive force differ in phase, the power can not be obtained by taking the product of the current and electromotive force. A factor must be introduced which will take account of this phase difference; this can be obtained as follows:

Let $e = \mathbf{E} \sin 2 \pi n t$ represent the electromotive force at any instant in Fig. 2, then the current at the same instant will be $i = \mathbf{I} \sin (2 \pi n t - \phi)$. The instantaneous power $= e i = \mathbf{E} \mathbf{I} \sin 2 \pi n t \cdot \sin (2 \pi n t - \phi)$, $\mathbf{E}$ and $\mathbf{I}$ being the maximum values of the electromotive force and current as before. Now $\sin (2 \pi n t - \phi) = \sin 2 \pi n t \cdot \cos \phi - \cos 2 \pi n t \cdot \sin \phi$, and hence $e i = \mathbf{E} \mathbf{I} \sin^2 2 \pi n t \cdot \cos \phi - \mathbf{E} \mathbf{I} \sin 2 \pi n t \cdot \cos 2 \pi n t \cdot \sin \phi$, and average of values of instantaneous power = average $e i =$

$$\mathbf{E} \mathbf{I} \cos \phi \text{ av. } \sin^2 2 \pi n t - \mathbf{E} \mathbf{I} \sin \phi \text{ av. } \sin 2 \pi n t \cdot \cos 2 \pi n t .$$

Now the average value of $\sin 2 \pi n t \cdot \cos 2 \pi n t$ is zero because it passes through positive and negative values alike, consequently

$$\text{average power} = \mathbf{E} \mathbf{I} \cos \phi \text{ av. } \sin^2 2 \pi n t,$$

but $\mathbf{E} = \sqrt{2}\ \mathrm{E}$ and $\mathbf{I} = \sqrt{2}\ \mathrm{I}$, when E and I are the volts and amperes (square root of mean square values), as indicated by the measuring instruments. The average value of $\sin^2 2 \pi n t$ is $\frac{1}{2}$, hence

$$\text{average power} = \sqrt{2}\ \mathbf{E}\ \sqrt{2}\ \mathbf{I} \cos \phi \cdot \frac{1}{2} = \mathrm{EI} \cos \phi .$$

Or in a single-phase alternating-current circuit, the average power supplied is obtained by multiplying the product of the volts and amperes by the cosine of the angle of phase difference between the current and electromotive force. In passing, it may be noted that in a single-phase circuit the power pulsates with a frequency double that of the current or electromotive force, as is easily seen by referring to Figs. 1 and 2. The product EI is the number of volt-amperes or apparent watts found by multiplying the instrument readings together. Hence, in order to get the actual watts expended it is necessary to multiply the apparent watts by $\cos \phi$. This factor is called the power-factor of the receiving device or circuit, and is best defined by the relation

$$\text{power-factor} = \frac{\text{actual watts}}{\text{apparent watts}}$$

From the above it is seen that the power-factor is, in single-phase circuits, numerically equal to the cosine of the angle of phase difference between current and electromotive force. Evidently the power-factor becomes equal to unity when the electromotive force and current are in phase and it can never have a value greater than unity. Later on it will be seen that the quantity $\cos \phi$ as applied to a multiphase circuit is somewhat indefinite because the angle ϕ may have a different value in each of the phases of a system and it is therefore best to define the power-factor as the ratio of the true or actual watts to the apparent watts or volt-amperes, or as the factor by which the apparent watts must be multiplied to give the true watts. Since average power $= \mathrm{EI} \cos \phi$ it is easily seen that when the angle of lag becomes ninety degrees, $\cos \phi = 0$ and the power delivered becomes zero, even though there may be a considerable current flowing under a high impressed electromotive force. In this case the current is wattless, and in a figure similar to Fig. 2 the shaded areas of the power which come below the horizontal would become equal to those above. If ϕ should be more than ninety degrees, $\cos \phi$ becomes negative, thus making the power negative and indicating that power is being returned from the receiving device.

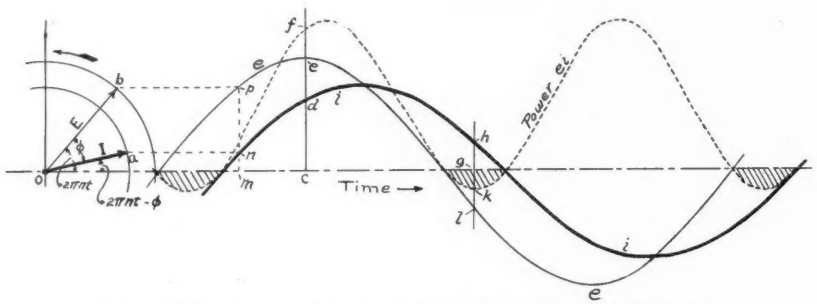


FIG. 2.—POWER MEASUREMENT ON ALTERNATING-CURRENT CIRCUITS.

Having glanced briefly at some of the points affecting the determination of power in alternating-current circuits, let us consider a few of the more important methods of making power measurements. In doing so wattmeter methods alone will be taken up. It has just been shown that the phase difference between current and electromotive force has an important bearing on the amount of power, hence it is desirable to use an instrument which will take account of this phase difference. A wattmeter does this and hence wattmeters are used almost exclusively for alternating-current power measurements. Methods have been devised for making such measurements by means of ammeters and voltmeters, but these methods are awkward, are liable to introduce large errors, involve more or less calculation, and are now seldom used.

The wattmeter is a modification of the Siemens dynamometer. It consists of a fixed current coil of a few turns of heavy conductor through which the current supplied to the receiving circuit flows. Inside of the current coil is suspended a fine wire coil which, in series with a non-inductive protective resistance, is connected across the circuit. When currents flow in the coils the swinging coil tends to arrange itself with its plane in the plane of the fixed coil. This movement is counteracted by suitable springs. The current in the swinging coil is proportional to the voltage, while the current in the main coil is equal or proportional to the current in the circuit. Now a given deflection of the movable coil depends upon a certain average or constant force action between the coils. For example, in Fig. 3 let a represent the potential coil in series with which is the protective resistance r, b is the fixed current coil and c c the circuit in which the power is expended. If e is the instantaneous value of the electromotive force applied to c c, then the current through the fine wire coil is $\frac{e}{r}$ assuming that the inductance and resistance of a are negligible. The corresponding instantaneous current in b will be i. The instantaneous force action or torque exerted between a and b will be proportional to the product of the two currents or will be $k \cdot \frac{e}{r} \cdot i$ and the average force which produces the deflection will be $\frac{k}{r} \cdot$ average $e i$ where k is a constant. But average $e i$ is the average power expended in the circuit, and the wattmeter will indicate the power expended no matter what the power-factor may be, because

its deflection is the average result of all the instantaneous force actions of the current and electromotive force, and the relative values of the current and electromotive force at each instant depend upon the phase relation. A wattmeter will not give accurate indications unless the current in the potential circuit *a r* is in phase with the applied electromotive force, but in good wattmeters the resistance of the potential circuit is so great as compared with its reactance that the angle of lag is very small and the indications of the wattmeter are practically correct.

If in Fig. 3 the power-factor of the receiving circuit were zero, *i. e.*, angle of lag ninety degrees, the circuit would return just as much energy as was given to it. The current would be wattless and in Fig. 2 the negative areas of the power curve below the horizontal would become equal to those above. The average torque action on the swinging coil of the wattmeter would therefore be zero and no deflection would result. This is as it should

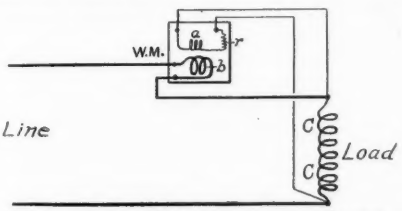


FIG. 3.—POWER MEASUREMENT ON ALTERNATING-CURRENT CIRCUITS.

be, because EI cos $\phi = 0$ and no power is expended. If the lag between the currents in *a* and *b*, Fig. 3, should become greater than ninety degrees, the coil of the wattmeter would reverse its deflection, and in order to get a deflection over the scale of the instrument it would be necessary to reverse the connections of one of the coils. The reading so obtained should therefore be considered as negative because the flow of energy is back toward the supply circuit. This action of the wattmeter should be kept in mind as it will be referred to later in connection with three-phase measurements.

POWER MEASUREMENT ON SINGLE-PHASE CIRCUITS.

The measurement of power on single-phase circuits calls for little comment. The wattmeter is connected as shown in Fig. 3, and for a given current will give its maximum reading when the power-factor of the load is one. If the power-factor becomes zero the wattmeter reading also becomes zero. If the angle of lag becomes greater than ninety degrees the resultant flow of energy reverses and the wattmeter reading also reverses. However, on single-phase circuits this reversal would not occur under ordinary conditions.

(To be continued.)

Ferrosilicon in France.

Consul-General Robert P. Skinner, at Marseilles, France, has made the following report on the status of ferrosilicon in France. This report has been made at the request of the *Iron Trade Review*, of Cleveland, Ohio. A paper read by M. Albert Keller before the Iron and Steel Institute in London, has also been appended:

Ferrosilicon manufactured by electrical process is now being shipped regularly in commercial and rapidly increasing quantities from France to the United States. It is being forwarded both from Grenoble, the shipping point nearest the place of manufacture, and Marseilles. During the year ended June 30, 1903, the exports from Marseilles amounted in value to $33,242, as compared with $196 in 1892, and there are evidences of an increasing demand and capacity to supply that demand. The concerns principally interested as manufacturers in this enterprise are the Compagnie Electrothermique Keller, Leleux & Company, 3 Rue Vignon, Paris (works at Livret-et-Gavet, Isère); the Compagnie Générale de l'Electro-Chine, Bozel, Savoie, and the Société Electro-Chimique de la Romonche, Livret-et-Gavet, Isère. The rapid development of this industry has been enveloped in all the mystery compatible with the marketing of the product. The shipments of the material are made by middlemen, who, not unreasonably, desire to retain as their own property such facts as may be called trade secrets.

In the French Alps the work of damming streams for the generation of electricity has been going on for about four years with feverish activity, and a region hitherto without important manufacturing enterprises bids fair to become a great producing centre. The engineers in charge feel that they have within their grasp a knowledge of electrometallurgy which must sooner or later free the country from its dependence on coal.

The first satisfactory discussion of the subject of ferrosilicon in France was made in May before the Iron and Steel Institute in London by M. Albert Keller. M. Keller is a graduate of the National School of Arts and Crafts at Angers, and under his direction electrical power has been installed in twelve electrometallurgical works. He has devised improvements in the manufacture of carbide of calcium, and has invented a process for the electrical treatment of iron ore and iron and steel waste. It will be surprising, indeed, if, with full knowledge of the work being done in France, the United States remains long behind in the competition for supremacy in the adaptation of electricity to metallurgical furnaces. M. Keller's paper follows:

THE ELECTROMETALLURGY OF SILICON.

Silicon, on account of its character as a thermal, chemical and mechanical agent in the metallurgy of iron and steel, forms as much a part of the groundwork of metallurgy as manganese, and with the commencement of the manufacture of ferrosilicon in the electric furnace the latter may be said to have achieved its entry into the domain of metallurgy, in which the success of its application has deservedly secured a lasting place for it. It had as a rival the blast furnace, in which ferrosilicon containing ten to fifteen per cent could be blown without difficulty when working very hot, notwithstanding which fact the electric furnace could readily enter into competition with it owing to the higher temperature attainable. The electric furnace, even when working at moderate temperatures, can produce without difficulty alloys richer in silicon than those yielded by any blast furnace, and it was by these means that ferrosilicon containing from twenty-five to eighty per cent silicon was first brought out.

The process of finding a market for the ferrosilicon manufactured in the electric furnace was at first rather slow. The products as supplied at the beginning were very impure, so that even the most favorably disposed users were at first discouraged. Taking into consideration, moreover, that the introduction of any new system or product is, generally speaking, always a matter of extreme difficulty, it will not be surprising to learn that in the past three years it was only during the last one that the advantages of high-grade ferrosilicon began to be appreciated. The use of it has now, however, so far extended that at the present time thirty and fifty per cent ferrosilicons are commonly employed in foundries and steel works; and it may be said that in competing with low-grade ferrosilicon the only question is now one of comparative economy, since metallurgists naturally prefer the product which provides them with silicon at the cheapest rate per unit delivered at their works, not omitting, however, to take into account the value of the iron contained in the alloy. That the electro-ferrosilicon can compete successfully with blast-furnace ferrosilicon is proved by the simple fact that the sale of the former of these products has now assumed very considerable proportions.

Formerly high-grade ferrosilicons la-

bored under various disadvantages, partly on account of their lower density and of the ease with which they were oxidized in the bath of metal compared to ten or fifteen per cent ferrosilicon, and partly on account of the fact that their melting point differs slightly from that of the low-grade alloy.

ADVANTAGES OF HIGH-GRADE FERROSILICON.

In enumerating the following advantages attending the use of high-grade ferrosilicon, the author entertains no doubt that a discussion will prove highly useful in bringing to light new points of interest bearing upon its application in the manufacture of iron and steel.

1. Purity—The degree of purity attainable in the electric furnace in making high-grade ferrosilicon is particularly noteworthy. In fact, generally speaking, the higher the content of silicon in the alloy the greater is its purity. This will be readily understood when it is considered that the increased percentage is obtained by using a larger quantity of silica and of reducing carbon without increasing the iron, the latter being just that constituent which introduces all the impurities subsequently found in the alloy. Besides this, for two given qualities of ferrosilicon, one containing twelve per cent and the other fifty per cent silicon, and each containing an equal amount of impurities, the percentage of impurities introduced into the bath of metal per unit of silicon is four times less in the case of the rich alloy than in that of the poor one. Finally, the manufacture of high-grade ferrosilicon necessitates a more powerful and prolonged calorific action, which aids the expulsion of impurities, either by volatilization or by secondary reactions.

The following is the current analysis obtained by the author for fifty per cent ferrosilicon:

Phosphorus	0.02
Sulphur	Trace.
Carbon	Trace.

2. Economic Advantages—In the manufacture of high-grade ferrosilicon on a large scale, the higher the proportion of silicon in the product the lower is the cost of production per unit of silicon. This is explained by the fact that the iron, which is the most important item influencing the cost price of low-grade alloys, becomes of much less account in the case of a high grade, the chief constituent being then the silicon, which is very cheap. Again, in adding ferrosilicon to a bath of metal, the cooling effect is proportionally less the smaller the mass to be added, which is a further argument in favor of the high-grade alloy. It is probable that in view of the increasing favor with which metallurgists regard the use of high-grade ferrosilcon, the time is at hand when silicon will be employed in no other form than that of the rich alloy, in the same manner as manganese is now used.

The question then arises: Is it possible, in substituting high-grade ferrosilicon for the poorer alloy, to meet the entire demand for silicon; or, in other words, (*a*) can the electric furnace attain an output sufficient to meet the whole demand? or, (*b*) can the electric process of manufacture sustain a successful rivalry against the blast furnace with regard to the price of production per unit of silicon?

To these questions the obvious answer is that if the present consumption exceeds the amount now manufactured by thermo-electric methods, this new industry is nevertheless susceptible of such rapid extension that it would soon be able to secure the whole market for silicon by lowering considerably the present current market value. In demonstration of this, it may be stated that the results of working have shown that the energy required for the production of one ton of thirty per cent ferrosilicon amounts to 3,500 kilowatt-hours. A hydroelectric works developing 10,000 effective horse-power upon the shaft of the turbines would therefore be capable of producing 16,000 tons of thirty per cent ferrosilicon annually, or nearly thirty tons per day. These figures are well within the range of possibilities, seeing that even now in Europe, and notably in France, several hydroelectric stations are in existence of a higher aggregate power than the above.

The works at Livet, in the Department of Isère, where the thermo-electric firm of Keller, Leleux & Company, is engaged in the manufacture of high-grade ferrosilicon by its own processes, have an available source of 15,000 horse-power. The author has recently inaugurated the process of manufacture at Livet which the same company formerly carried on at a smaller works, and he has found that with 4,000 horse-power applied to this particular process it is possible to turn out twenty tons of thirty per cent ferrosilicon per day. The works are also equally well adapted for manufacturing higher grades than this, and with the existing apparatus any required percentage in the product is obtainable. Up to the present time the highest grades which have been made contain seventy-five to eighty per cent silicon.

THE MANUFACTURE OF FERROSILICON BY ELECTRICITY.

The manufacture of ferrosilicon can only be carried on with real economy in a large installation consisting of powerful electric furnaces. Those at the Livet works are of 650 horse-power each. The raw material employed are preferably quartz, scrap iron and coke. Quartz is more suitable than sand, since the latter is often productive of obstructions in the furnace. Scrap iron and steel are to be preferred to iron ore, for the reason that, together with a pure quartz, the working proceeds without the formation of any appreciable quantity of slag. The purity of the product depends, therefore, entirely upon the care bestowed on the equipment of the works. The furnaces employed are of the resistance type.

The author does not propose to discuss here the details governing the cost of production of ferrosilicon in the electric furnace, but he can confidently predict that the lower selling price will shortly secure for the ferrosilicon produced by the electric method a preponderance in the market.

As the use of high-grade ferrosilicon becomes more general, the demand for electro-ferrosilicon will increase; for, as already mentioned, the cost of production per unit of silicon is lower the higher the content of silicon in the finished product. For the manufacture of one ton of ten to fifteen per cent ferrosilicon in the blast furnace, as much as three tons of coke are requisite, owing to the hot working and to the refractory nature of the slags. The process is thereby at once rendered too costly to compete on a large scale with the electrically produced ferrosilicon. If the additional cost of transport per unit of silicon in the case of alloys poor in silicon is considered, it may be concluded that the use of rich ferrosilicon is likely to be adopted, if solely for reasons of economy. The future of the electric furnace as applied to the metallurgical preparation of this alloy is therefore assured beyond question, and, for the reasons above mentioned, the development of the industry is likely to assume considerable proportions at no distant date.

Cheap Electric Light for Berlin.

An article in the *Frankfurter Zeitung* recently states that, commencing on January 1, 1904, the price of electric light in Berlin will be reduced twenty-seven per cent—from fifty-five pfennigs to forty pfennigs (13.1 cents to 9.5 cents) per kilowatt-hour—and that the price for electric light in Berlin will then be cheaper than in any other large city. This reduction was made to compete with gas-light.

Electrical Installation of the City of Brussels, Belgium.

The Character of the Work Necessary to Keep Up with the Growth of the City and Consequent Demand for Increased Service.

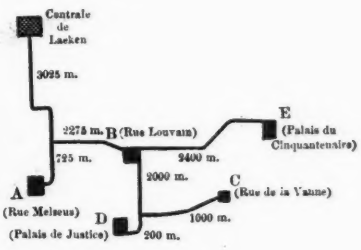
By Enrico Bignami.

IF there ever was an electrical installation which on account of adaptations and conditions which have been found necessary without ever having a radical transformation present great complexity, it is, without doubt, that of the city of Brussels. Even recently, when the necessity arose for a large new central station, instead of beginning that when the time was ripe, recourse was made to a number of complicated expedients in order to supply the demands for a few years in spite of the constant increase in the demands for electrical energy for power and lighting.

These expedients, although they only retard the final solution and can only suffice in a precarious manner, yet will repay the trouble of description on account of their ingenuity and because they can be adopted with good results in the whole solution.

It should be noted that last year before these were adopted there were three stations and there are still three feeding the distributing system of the city of Brussels, a system relatively very extended, as it has a total length of 340 kilometres of cable.

When the necessary extensions to the distributing system which these stations feed have been made, their capacities will have to be 2,400, 1,350 and 170 kilowatts, respectively. At the commencement of the last year the first station A had an output of 2,775 kilowatts, to which should be added an accumulator with a capacity of 675 kilowatts during a three-hour discharge. The second station B had an output of 620 kilowatts and in addition a

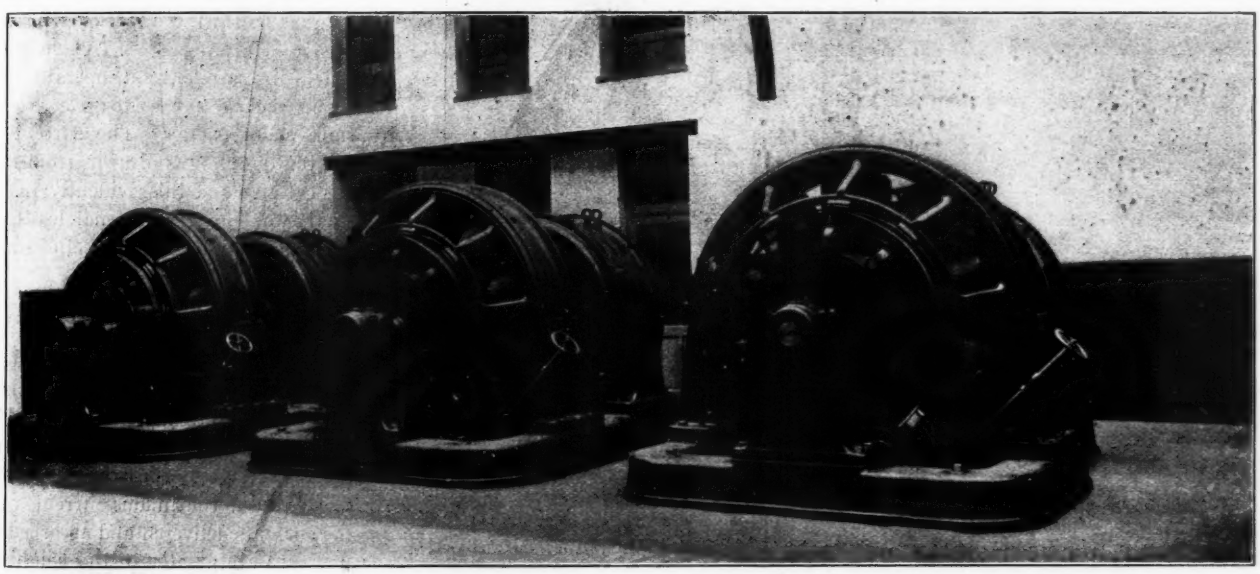


battery with an output of ninety kilowatts. The third station C had an output of 135 kilowatts with a battery of about thirty-five kilowatts during a three-hour discharge. The output of the stations was at that time about 3,450 kilowatts, 710 kilowatts, 170 kilowatts, so that the aggregate power was sufficient for the needs of the complete system, but the relative conditions of available space in the different stations had gradually brought about a division of power which could not in the end be satisfactory. For this reason it has already been necessary to transmit power from station A to station B by means of continuous currents at 260 volts.

With this condition of affairs, it became necessary to consider the effects of inevitable extensions to the distributing system. In order to provide for immediate needs a steam engine with an output of 1,000 horse-power and a dynamo of 675 kilowatts were ordered to reenforce station A, which station still had sufficient space to accommodate it, and it was proposed to resort to an arrangement capable of increasing considerably the available output of station B by a method more satisfactory than the transmission by direct currents. This station is greatly confined and already completely occupied by gas engines.

Experts were called in and they declared that the only satisfactory solution would be the construction of a single new station equipped in such a way as to provide for all future needs of the distributing system. This should be erected without the city before the winter of 1904. To provide provisionally for the lack of the present stations, they recommended the adoption of an arrangement which could be used entirely in the future and which involved no other new expense than the setting up of the third 1,000-horse-power engine, which had already been decided upon in station A. This machine is efficient and can be used with superheated steam and it will be installed later on in the new station; the continuous-current dynamo being replaced by a 675-kilowatt generator.

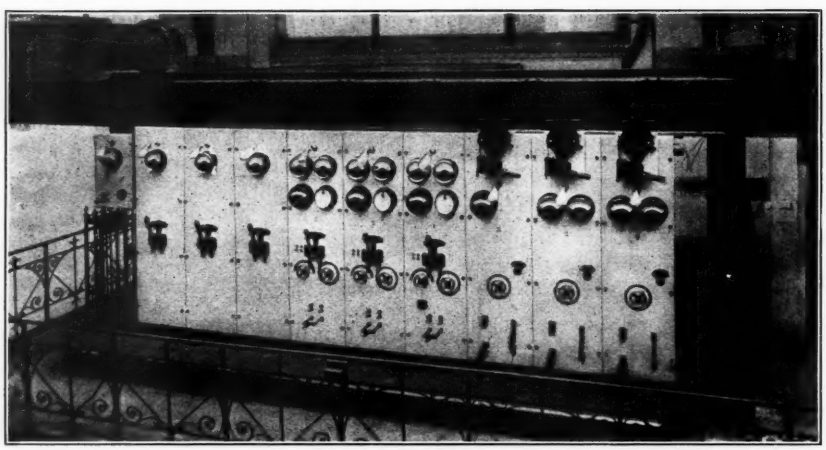
To reenforce station B it was proposed that motor-generators be installed. These are composed each of a three-phase synchronous motor receiving current at a



375-KILOWATT MOTOR-GENERATORS, SHOWING DIRECT-CURRENT SIDE, ELECTRICAL INSTALLATION, CITY OF BRUSSELS, BELGIUM.

high tension from station A and a continuous-current dynamo developing low-tension current for the distributing system. Later these motor-generators will be supplied from the new station, the current being fed from station A and this will be done without necessitating any modification. In order to transmit energy from A to B three three-conductor cables with copper conductors 180 millimetres in cross-section and which are already installed will be used. These sets will take the place in station B of two gas engine groups, which themselves will be used to reenforce station C.

To provide temporarily at station A for the high-tension currents which are to feed station B and to avoid installing a new generating unit at A, two similar motor-generator units will be installed there. These units will temporarily be operated reversed, that is to say, the low-voltage dynamo fed by the continuous current produced at A will run as a motor driving the three-phase motor as a generator and supplying high-tension current to the cables running to B.



DISTRIBUTING SWITCHBOARD, FRONT VIEW, ELECTRICAL INSTALLATION OF THE CITY OF BRUSSELS, BELGIUM.

When the new station is installed, the operation of these units will be reversed, that is to say, the three-phase machines will receive current from the new station and they will operate as motors driving the continuous-current dynamos which will feed the low-tension distributing system from station A. This reversed operation can be effected without necessitating much expense. These machines eventually will be insufficient to feed the distributing system, so that it will be necessary to add a sufficient number of identical units which will take the place of the present steam units.

This advice of the experts as to the manner of meeting the difficulties of the moment was carried out effectively.

TRANSFORMERS.

The addition of a steam unit of 675 kilowatts at A and the transfer of two gas units of about eighty kilowatts each from B to C make the available output of the three stations about 4,235, 550 and 250 kilowatts each, respectively.

The possibility of transmitting 1,125 kilowatts from station A to station B will make the available output of the stations about 3,000, 1,675 and 250 kilowatts, an output sufficient to feed the three sections of the network during the winter seasons of 1903. Consequently, the installation of six groups of identical transformers each of 125 kilowatts, three of which operate the motor-generators at station A (Fig. 1) and the three-phase motors and continuous generators at station B, was called for and decided upon. To satisfy the conditions of identity of all the groups and to make it possible to reverse the operation of three of them, the two machines of each group were ordered with the same normal output of 375 kilowatts or 510 horsepower.

The order for these groups of transformers and the switchboard accompanying them was placed with the Société Anonyme L'Union Electrique, which constructed them and put them in service, complete, in but four months.

These groups are composed of a continuous-current dynamo excited in shunt with an output of 1,500 amperes at 250 volts normal load and of an alternator with an output of 43.3 amperes at 500 volts normal load. These machines are supported on three bearings on a common base and run at 375 revolutions per minute. The dynamo has six poles, the revolving field on the generator has sixteen and produces current at a frequency of sixty cycles per second.

TRANSMISSION.

Consider now under what conditions the total efficiency of transmission from station A to station B will be made. This transmission involves four transformations of energy and includes evidently losses, in addition to those taking place in the machines. That is to say, there are losses in the connections between the machine and the switchboard and in the transforming and measuring apparatus and in the line. In the actual case line losses are negligible, as the two machines are connected by three-phase high-tension cables formed of three conductors of 180 square millimetres. The losses in the connections and in the switchboard are also small.

Finally, to take account of the practical conditions of transmission, a test was made at station A, where all the connections are longer than at B, which gave the final efficiency, by a method analogous to that of Lord Rayleigh and Kapp. Continuous current was fed to the direct-current side of two transforming sets. These were connected in parallel, but operated inversely in such a way as to give a local transmission of energy. The current to supply the losses was drawn from the storage battery, and this evidently represented the total of the internal losses of the machines and in the connections and switchboard.

In this test the normal voltage of the three-phase system, 5,000, was generated, but the machines were fed by a continuous voltage of 220 volts, while the ordinary voltage of service of these machines varies practically between 228 and 232 volts, and the normal voltage by construction is 250. At this reduced continuous-current voltage the currents delivered and absorbed by the dynamos are greater in the neighborhood of thirteen per cent than the normal currents, and the losses are in consequence greater by about twenty-seven per cent to the normal loss. In addition, a test was made at a frequency of about eight per cent higher than the normal.

SWITCHBOARDS.

Each of the two switchboards of stations A and B consists of nine large fixed panels, three of which are for the lines, three for the three-phase machines and three for the continuous-current machines. There is in addition a small swinging panel, upon which is mounted the synchronizing apparatus.

The principle adopted in the construction of these switchboards is the separation of high-tension apparatus, so far

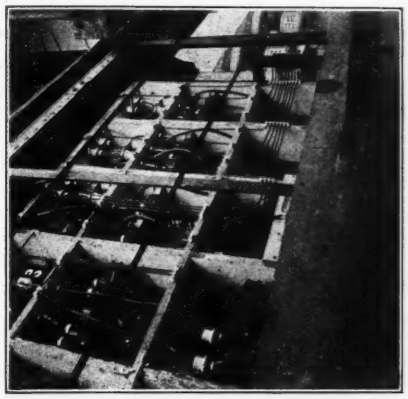
as this is permitted by the restrictions of space, the idea being to localize trouble. Another principle was the doing away with high-tension apparatus on the front of the board. The measuring and regulating apparatus which must be mounted on these panels is supplied by current or voltage transformers according to the nature of the apparatus.

For the purpose of separating the apparatus, seven vertical brick walls tied to the rear wall of the room, which is about 2.4 metres behind the marble panels, were constructed. Copper bars supported by insulators fixed to horizontal iron angle bars pass through the five intermediate walls, and occupy the lower part of each compartment and are separated from one another by sheets of compressed cork placed between two asbestos boards. Above these bars are the hand switches and the break switches, also separated from the bars and from themselves by similar partitions. The metallic framework forming the upper part of the switchboard is composed of seven bars passing from the angle iron surrounding the panels to the brick partitions. These bars are about 2.4 metres above the floor. On these bars are placed longitudinal iron plates. Partitions of cork and asbestos are placed vertically along the bars, separating the superstructure into compartments. Other vertical partitions placed along on the plates of iron separate the large compartments into smaller compartments. No compartment includes more than two transformers. Each of the larger compartments corresponding to one line includes the terminal of a three-phase cable, an automatic three-pole oil break switch, a hand switch and part of the high-tension bus-bars. The automatic interrupter includes two relays placed on the panels and two current transformers placed on the superstructure. Each of these main compartments at station A includes in addition a current transformer for connecting the load supplied by each line.

Each of these main compartments of the switchboard corresponding to an alternator includes the terminal of a three-phase cable going from the alternator into an automatic three-pole oil break switch, a hand switch and one section of the high-tension bus-bars. As for the lines, the automatic interrupter includes two relays placed on the panel and two transformers placed on the superstructure.

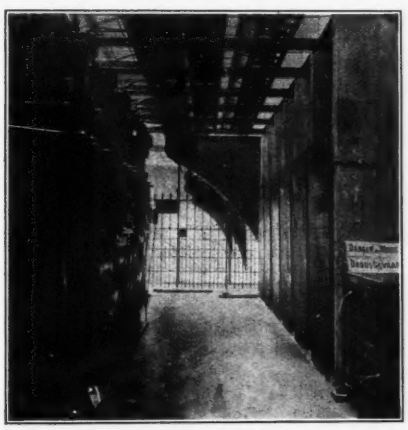
In the middle of each panel is a handle for controlling the oil break switch. These panels also support the field rheostat for its corresponding alternator. The field rheostat of the continuous dynamo is placed at a distance, and the controlling handle is coupled to that of the alternator by means of a sprocket chain.

At station A the panels corresponding to the continuous-current machines include the terminals of the cables passing from these machines, the terminals of the bus-bars and those of the cables passing to the larger switchboard of the



VIEW FROM ABOVE, SWITCHBOARD, ELECTRICAL INSTALLATION, CITY OF BRUSSELS, BELGIUM.

station. In addition there are on the negative board a shunt ammeter and a magnetic blowout circuit-breaker of the Thomson-Houston type. On the positive side there is a switch and a single-pole quick-break interrupter. In shunt with this interrupter is placed a four-point switch which serves to introduce the starting rheostat and to short-circuit sections of this successively.



REAR VIEW, SWITCHBOARD, ELECTRICAL INSTALLATION, CITY OF BRUSSELS, BELGIUM.

At station B bus-bars have been done away with, each dynamo being connected to the terminals of the accumulators and the bars previously serving to feed the exciting circuits of the alternators are connected to a fourth feeder, that on which are produced during the day the small variations of voltage at the station.

The starting rheostats are placed in the rear at some distance from the continuous-current panels, against the wall to which are fastened the brick partition walls forming the six masonry compartments. Each switchboard has six incandescent lamps, one for each panel, whether fixed or movable.

The direct-current instruments are electromagnetic, those for the alternating-current are of the hot-wire type. The phase meters are revolving field instruments.

THE SYNCHRONIZING PANEL.

This panel contains a voltmeter and a switch, to which are run conductors from the three voltage transformers. These transformers are connected in triangle and placed in the switchboard compartment for the third line. There are also two synchronizing lamps which by means of a double-pole switch and a four-pole plug switch may be connected to any set of generator voltmeter leads.

Assuming an alternator to be running at normal speed and in phase with the bus-bars, it is in condition to be connected to these. The secondaries of the two transformers give two electromotive forces which act together. The two lamps are in series with these secondaries and light up. The voltmeter is in shunt and arranged in such a way as to divide the circuit into two symmetrical parts and it stands at zero in this condition. If the speed of the alternator does not correspond to the frequency of the bus-bars, the illumination of the lamps varies. When they are quite dark the two secondary electromotive forces are in opposition and the voltmeter indicates the condition of the bars and the reflectors; that is to say, 5,000 volts. The alternators are connected in parallel on the other hand, when the two lamps burning at their brightest point show that the oscillating needle of the voltmeter stands for an instant at zero. This method is practically very safe.

By the expedients mentioned above, the administration of the city of Brussels can provide for the present needs of the city, which needs consist of 160,000 incandescent lamps, more than 1,000 arc lamps and where a number of small and moderate size stations are fed by electrical energy from one of the three stations.

The new central station which will be erected at Laecken will contain the following machinery: three 2,000-horse-power engines and the three 1,000-horse-power engines now in station A, these will be coupled to alternators with an output of 1,500 and 750 kilo-volt-amperes, respectively. There will also be two 200-

kilowatt exciters and a suitable battery equipment.

In addition there will be required at station A four motor-generators with an output of 750 kilowatts and a compensator with an output of 200 kilowatts; at B six motor-generators with an output of 375 kilowatts and one 100-kilowatt compensator; at C three motor-generators with an output of 100 kilowatts and one fifty-kilowatt compensator. It will also be necessary to install two new distributing centres, the one D of 300 kilowatts and the other E of 200 kilowatts. The arrangement of these is given in the accompanying diagram.

The annual increase of the maximum demand is computed at 380 kilowatts.

The electric tramways at B possess at present two stations, one on Rue Braguiez and the other on Avenue de L'Hyppodrome, but before long they will operate the following new installations:

A central station at Anderlecth containing four 2,800-horse-power engines driving alternators with a frequency of twenty-five cycles and generating current at 6,600 volts, and three 100-kilowatt exciters with a small battery.

A substation at Rue Brouguiez containing five 550-kilowatt synchronous converters, a seventy-five-kilowatt starter and a small battery.

A substation on Avenue de L'Hyppodrome containing three 550-kilowatt synchronous converters and a seventy-five-kilowatt starter and a small battery.

A substation on Rue Verte is similar to the last mentioned.

The central station will contain later 1,500-kilowatt units. Brouguiez will have six or more converters, Hyppodrome and Verte six converters. These arrangements are provided for doubling in the future the equipment at the central station, giving fourteen 1,500-kilowatt units. The entire installation was made by the Union Elektricitaets Gesellschaft, of Berlin, associated with the Thomson-Houston Company. The switchboards are very interesting and were supplied by the parent company, the General Electric Company of America.

Italian Tramways.

The inspector-general of the Italian tramways has issued a report covering the year 1900. This report has been delayed by the difficulty with which information has been obtained from the various companies. At the close of December, 1900, the total length of tramways in Italy was 3,343.5 kilometres, of this 2,952.9 kilometres operated by steam and 390.6 by electricity. The electrical equipment included 1,043 motor cars and 869 trailers.

Official Automobile Blue Book.

The 1903 edition of the Official Automobile Blue Book brings this valuable guide up to date. This issue covers the states of New Hampshire, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland and the District of Columbia. The states are divided into sections, and the available routes lying in these sections are carefully tabulated. Each table gives detailed information of each section of the route, the towns passed, the distances covered, the nature and condition of the road and the grades. All supply stations lying on these routes are noted in the table. Supply stations are classified so that the tourist can tell at a glance what character of work can be obtained. These tables have been compiled with great care and have been verified by local representatives. In addition to the charging stations, hotels lying along the route are listed.

As new roads are opened or changes made along old roads, bulletins are issued by the publishers of the Blue Book, which are of such size that they can be inserted in the book, keeping it always up to date and reliable.

The book also contains good indexes, reference to which enables the tourist to locate at once the route he desires to take.

In addition to the information above, the book gives a summary of the state and federal regulations of the territory covered. This book should be a valuable part of the equipment of every automobile tourist. It is edited by Mr. C. H. Gillette and published by the Official Automobile Blue Book Company, 41 West Thirty-second street, New York.

The same company also publishes five touring maps printed in three colors and covering the following districts: Lower New England, eastern New York, western New York, New Jersey and Long Island, Pennsylvania, Baltimore and Washington. When desired, these maps are furnished in a convenient case for holding and protecting them.

Production of Chromite in 1902.

The report to the United States Geological Survey on chromite for 1902, by Dr. Joseph Hyde Pratt, is now in press.

California was the only state producing any chromite during 1902, the quantity being 315 long tons, valued at $4,725. This is a decrease of fifty-three tons in quantity and of $1,065 in value as compared with the production in 1901, which was 368 long tons, valued at $5,790.

The Pacific Coast offers a promising field for the erection of a chemical plant to treat chrome ores in the manufacture of various chromium salts, as these ores can be obtained in California.

With the completion of the railroad from Erwin, Tenn., to Marion, N. C., the chromite deposits of Yancey County, N. C., will undoubtedly be thoroughly exploited and may become producers.

There is a large amount of chromite ore imported each year into this country, the most of which is from Turkey, with smaller amounts from New Caledonia and Canada. The imports of chrome ore and chromic acid in 1902 were valued at $593,712. The principal chromite deposits of Canada are in the vicinity of Black Lake and Coleraine, Quebec Province. The Canadian production for 1902 was 900 long tons, valued at $13,000.

Submarine Cables of the World.

In a recent address before the London Chamber of Congress, Mr. Charles Bright stated that the total length of submarine cables now amounts to over 200,000 nautical miles, representing a total investment of about $250,000,000. The present market value of the combined capital of these cables largely exceeds this figure. The cable construction and shipping output of Great Britain is about 100 nautical miles per day. The cost of construction may be estimated at $750 per mile and the cost of laying at about half as much. A cable carefully manufactured and laid, if the conditions of the sea bottom be favorable, should be expected to last thirty years or more. It might be kept in operation indefinitely by the successive replacement of the parts. The cost of maintenance is usually put down at from $30 to $40 per mile per annum, though there is always the possibility that heavy expenses may be called for to make repairs. Deep-sea cables have generally proved very remunerative. About 6,000,000 cable messages are now sent in a year, having increased out of all proportion to the increased mileage of the cables.

Transactions of the American Institute of Electrical Engineers.

Volume xix of the transactions of the American Institute of Electrical Engineers has been issued. This covers the period from January 1 to July 1, 1902, and contains the papers and discussions presented during that period, including the convention at Great Barrington. In spite of the fact that it was decided to publish the transactions of last year in two volumes, this volume contains over 1,200 pages and does not include the list of members, while the volume for the whole year of 1901, exclusive of the list of members, contains 956 pages. This comparison illustrates the large amount of work which the Institute accomplished under the presidency of Mr. Charles P. Steinmetz. The frontispiece to this volume is an excellent likeness of the secretary, Ralph W. Pope.

THE CATHODE-RAY ALTERNATING-CURRENT WAVE INDICATOR.[1]

BY HARRIS J. RYAN.

(Concluded.)

I have usually adjusted this circuit so that a current of 0.2 ampere passed L′. and one ampere circulated through the resonant circuit C L″ A c_2 c_2. Thus arranged the third harmonic will be reduced to one-third compared with the fundamental in passing L′; a further reduction of one-third of the third harmonic occurs through L″ which acts as a throttle for all harmonics while the condenser passes the third harmonics with a facility measured three times as easily as for the fundamental. A further reduction factor of five to one acting alike against the third as well as all higher harmonics is applied by the current multiplying process due to resonance. All current circulated through C L″ A c_2 c_2 due to resonance must have the simple sine form so long as the saturation magneto-motive forces utilized by the iron cores are small compared with those used by the air cores in the magnetic circuit of L″. Thus it is seen that there are approximately the following factors which combine to cut out the third harmonic.

$$5 \times 3 \times 3 \times 5 = 135$$

which means that in the above circuit the value of the third harmonic compared with the fundamental circulating through c_2 c_2 has been reduced to one hundred and thirty-fifth of the original value existing in the electromotive-force wave impressed by the source upon this circuit at a' c'. Since even in very bad cases of wave distortion in electromotive-force generation the third harmonic will not exceed one-third of the magnitude, it follows that the ratio of the fundamental and third harmonic values of the current through c_2 c_2 is about four hundred. Since the higher harmonics are eliminated to a greater extent than the third it follows that the deviation of the current wave through the coils, c_2 c_2, that are to produce the standard known motion of the ray, from the cyclic variation of a true sine wave is less than one-quarter per cent, an accuracy that is ample for the purposes involved.

By means of the analytical methods published by Steinmetz, the exact degree of expurgation of irregularities in the wave of the original source is easily computed where "open" magnetic circuits employing straight cores operated at low flux densities are used in making up the inductances L′ and L″.

The degree to which the above expurgation of irregularities will occur in actual operation has been examined carefully in a number of ways and found to be about as described above.

When the unknown current through M and the coils at c_1 c_1 and the sine wave current through the coils at c_2 c_2 are established at the same time, the spot of light on the screen in the cathode-ray tube is given a motion that is the resultant of two motions at right angles to each other and proportional to the instantaneous values of their corresponding currents. Owing to the persistence of vision, this results in the production of a closed card upon the screen traced by the spot of light. A record of this card may be made in various ways. I have generally used one of the two following methods:

1. The card may be easily photographed in the ordinary camera using five seconds exposure.

2. It may be traced on a smoked glass mounted in front of the tube by keeping the eye at a fixed point of view.

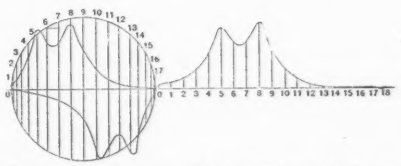


FIG. 5.—METHOD OF TRANSFERRING CARD TO RECTANGULAR COORDINATES.

I have generally preferred to record the cards by photographing them.

Ordinarily the detail of the pressure wave with respect to the current wave that is established is also desired. By means of switches S_1 S_2 and DPDT in Fig. 4, the coils at c_1 c_1 can be disconnected from the circuit a'' M c'' and connected in the circuit which draws current through a non-inductive resistance a''' R c'''. This produces a card due to the pressure wave-form impressed upon the machine or apparatus at M. Obviously, when the currents through M and R differ widely in magnitude, an extra set of coils may be mounted concentric with the coils c_1 c_1 through which to receive the current controlled by the non-inductive resistance R. Both cards may be photographed on the same plate when a true record is obtained of instantaneous values and phase relations of the unknown electromotive force and current applied at M. To enable the values to be plotted in rectangular coordinates, the axis of the standard or sine wave should also be recorded. This is easily done by removing the current from the coils c_1 c_1 and recording the line of light produced by the sine motion that remains due to the standard current in the coils c_2 c_2.

If a polyphase source is employed it is best to apply the sine wave current through the coils, c_2 c_2, from a pressure phase-changing device. This is easily and obviously arranged by means of a set of autos having a number of pressure taps or by means of a movable coil mounted in a revolving field such as is provided by every induction motor that has a wound secondary. Thus the phase position of the sine wave can be adjusted so as to cause the more intricate portions of the unknown wave-form to occur at the time when the sine wave motion is most rapid, *i. e.*, when the sine wave current is passing through zero. In this manner the resulting cards can be so adjusted as to bring out the desired detail to the fullest and clearest extent.

In a simple and obvious manner the values of the unknown wave may be taken from its card and plotted with time in rectangular coordinates. One way of doing this is illustrated in Fig. 5. A circle is drawn using the sine wave as a diameter. Upon this circle a number of equidistant points are located corresponding to the number of points to be used in plotting the wave in rectangular coordinates. Ordinates to the sine wave diameter of this circle will intercept the card at uniform time intervals. The lengths of the ordinates from the card to the diameter are proportional to corresponding instantaneous values of the wave and may be transferred without change to the rectangular diagram to form the actual wave as shown in Fig. 5.

The scale that applies to the instantaneous values is determined by comparing the effective value of the observed wave with the reading of an alternating-current ammeter placed in series with the sine wave coils, c_2 c_2. This ammeter is read at the time that the card formed by the unknown wave is recorded. The ratio between the deflections of the ray produced by the coils c_1 c_1 and c_2 c_2 is easily obtained once for all by means of observations taken with continuous currents and instruments.

The half-tone in Fig. 6 was made from a photograph of a set of cards and their axes as they were formed on the screen of the cathode-ray tube. In making these cards the method was being employed in a study of the conductivity of the atmos-

[1] A paper read at the twentieth annual convention of the American Institute of Electrical Engineers, Niagara Falls, N. Y., July 2, 1903.

phere about a line conductor subjected to high pressure. The card LC was formed by the line-charging current and the card CC by the charging current supplied to an air condenser for the purpose of determining the electromotive-force wave impressed upon the line. The coils corresponding to c_1 c_1 in Fig. 4 in this instance contained a total of 46,000 turns which would enable cards to be formed with currents of from 0.0006 to 0.006 ampere, *i. e.*, from 0.6 to 6 milliamperes. The effective electromotive force employed was 40,000 volts at 120 cycles.

In order to use this cathode-ray instrument on high-pressure circuits some natural precautions must be taken. The tube, coils, Wimshurst machine and camera must be completely enclosed in a wire cage set upon high-pressure insulators and connected to one terminal of the high-pressure source. The branch L″ A c_2 c_2 delivering the standard sine wave from the low-pressure source must be protected by inserting an insulating transformer so as to separate with an ample dielectric the coils c_2 c_2 and the remainder of the low-pressure circuit L″ A a_1'. Such an insulating transformer is easily provided by mounting primary and secondary annular coils having a transformative ratio of 1:1 upon a straight open-circuit core and separated therefrom by a suitable space to be occupied by the dielectric and then by immersing the whole transformer in ordinary kerosene. Obviously all metallic circuits within the high-pressure cage should be rounded to it. In this manner I have found that many of the interesting atmospheric conduction phenomena that occur in high-pressure work may be studied experimentally in a satisfactory manner.

I think that this apparatus will in the future be found of use in observing the behavior of hunting currents in synchronous machinery, commutation in continuous-current machinery, the characteristic manner of current interruption produced by fuse cutouts, and circuit-breakers and electric surges on long lines.

As was shown above, it is easily applied where cyclic phenomena are to be observed. It can, however, frequently be used effectively for observing values that occur only as sudden impulses, by having the current constituting the sudden impulse through one circuit and a uniformly increasing current through another circuit occur simultaneously and arranged so as to act magnetically upon the cathode ray. A momentary trace showing the nature of the impulse is thus drawn across the fluorescent screen.

When I determined to examine into the fitness of the Braun type of cathode-ray tube for engineering research work I found that the tubes on the market were altogether too small to be of practical use. In the summer of 1900 Mr. Muller-Uhri, of Braunschweig, Germany, undertook to make for us two tubes in which the screens would be as near to six inches in diameter as he could make them. The glass work is difficult and only after a

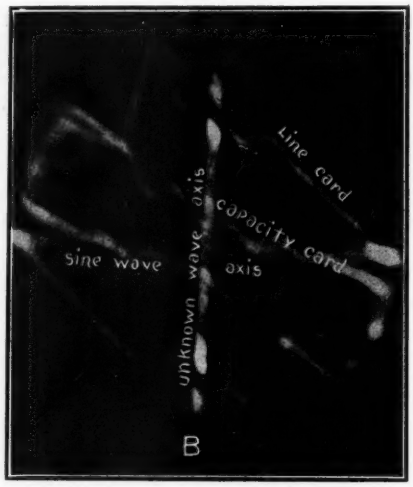


FIG. 6.—CATHODE-RAY ALTERNATING-CURRENT WAVE INDICATOR.

number of trials did he succeed in making two in which screens were five inches in diameter. These landed in my laboratory in safety. A drawing to scale of one of these tubes is given in Fig. 1.

At the outset I was greatly disappointed in the behavior of this large size of tube compared with that noted in the small tubes. The cathode ray produced by the discharge from the influence machine was intermittent and almost wholly unsatisfactory. During the next two years

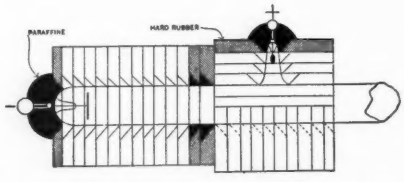


FIG. 7.—TUBE ENCLOSED WITH HARD RUBBER JACKET.

I spent such available time as I could spare in a study of the causes of this intermittent character of the ray. The trouble was finally traced to conductivity of the atmosphere that occurs at the rather high pressure that must be applied between the cathode and anode of the tube. The pressure required will spark a distance of three-eighths of an inch between three-inch balls. As soon as the real cause of the trouble was understood the remedy was easily found and applied.

To cause the formation of a continuous steady ray, therefore, it is necessary to jacket the tube at the cathode and anode portion with an ample solid dielectric. Oil for this purpose is a complete failure because it is too mobile. The best manner as yet that I have found for applying the jacket, so as to keep the air away from the immediate exterior of the electrodes, is shown in Fig. 7. The jacket is built up from quarter-inch hard rubber discs and half discs cemented to the walls of the tube with paraffin in the manner illustrated.

Such a jacket completely overcomes the unsteadiness of the ray, enabling one to operate the tube from an ordinary Wimshurst machine by connecting its cathode and anode direct to the terminals. All metal parts and connections from the Wimshurst to the tube should nowhere have a radius of less than one-eighth of an inch, *i. e.*, the conductor should be at least one-fourth of an inch in diameter.

I have found that a Wimshurst using six pairs of seventeen-inch micanite plates, driven at 200 revolutions per minute, would furnish about all the current that may be passed through the tube without puncturing. This gives a most brilliant spot of fluorescent light upon the screen. While attempting to drive more current through one of the tubes it was punctured when operating the Wimshurst at a speed of about 250 revolutions per minute. This tube will operate satisfactorily with the discharge from a Wimshurst having a single set of eighteen-inch plates. The amount of light at the spot seems to be proportional to the current discharge through the tube, and therefore to the number and size of the plates used in the construction of the Wimshurst.

Mr. Muller-Uhri is now prepared to supply these extra large tubes to the trade at an export price of about $20 at Braunschweig, Germany. The rubber jackets described above must be mounted after the tubes have been received from the maker. Doubtless in the near future some method will be found that will enable the maker to mount upon the tubes a proper and sufficient jacket before sending them out.

I wish to acknowledge the efficient and extensive assistance rendered by Professor J. O. Phelon in the early work done upon these large tubes, whereby I was ultimately able to trace the real cause of the intermittent character of the cathode ray.

Tungsten, Molybdenum, Uranium and Vanadium in 1902.

According to the report to the United States Geographical Survey for 1902, by Dr. Joseph Hyde Pratt, the production of crude tungsten ores during 1902 amounted to 183.5 tons, of which not more than a few tons were sold. The production of 1901 was 179 tons of concentrated ore, valued at $27,720. The larger part of the production of 1902 was from Colorado, with a smaller amount from Connecticut. No new localities were developed during 1902.

Almost the entire production of commercial molybdenite was by the Crown Point Mining Company, of Seattle, Wash., from its property in the western part of Chelan County. The production amounted to about twelve tons. The value of the ores is very erratic, the prices quoted varying from $1,500 to $100 per ton.

There was a marked increase in the production of uranium and vanadium minerals in 1902, which, as reported to the Survey, amounted to 3,810 tons, valued at $48,125, or $12.63 per ton. This, of course, represents the crude ore. In 1901 the production was 375 tons of crude ore. A portion of the uranium ore was treated, giving a concentrated product of twenty-five tons, which was valued at $8,000, or $320 per ton.

Although it has been determined that these metals have beneficial effects when used in the manufacture of steel, considerable study of them is necessary before their commercial position with respect to one another or to nickel and chromium can be definitely determined. Questions came up as to which of the various irons hardened by them are best adapted for steel drills, for dies and shoes in stamp mills, for car axles, carpenters' tools, etc., as to which will retain the best cutting edge, which will heat the least when in use, and which will make the toughest iron.

Mr. A. B. Frenzel, of Denver, Col., has offered prizes at a number of the schools of mines in the United States for investigations of these ferroalloys in relation to the matters mentioned above, and they would seem to offer an inviting field for investigation by the Carnegie Institute.

Gutta-Percha in the Philippines.

A supplementary report on the gutta-percha supply in the Philippines has been made by Dr. Penoyer L. Sherman, Jr., of the Philippine Forestry Bureau. In this he describes an expedition made in search of gutta-percha trees, and confirms the belief that a considerable supply exists in the Philippines, though as yet the most valuable species of trees has not been recognized there. Explorations of large portions of the Island of Mindanao and the Islands of the Sula Archipelago resulted in the discovery of several species of trees. It is found also that the Chinese have built up a much larger trade in this product than has been indicated by the customs returns. The amount of gutta-percha which paid an export duty to the Philippine authorities during the twelve months ending June 30, 1902, was 373,331 pounds, though but 14,000 pounds were credited to the Philippines. In Mindanao, the natives say that all of the mountain regions of the south contain gutta-percha, and the explorations so far as carried confirm these statements. Dr. Sherman found gutta-percha trees, some of which were felled for him by the natives and the gum extracted by the usual methods. One tree, 160 feet in height and eight feet in circumference, yielded nine and one-half pounds of dry gutta-percha. Had the tree been ringed and precautions taken to get all of the milk, it is thought that it would have yielded twenty pounds; while, had the bark and leaves been secured, it probably would have yielded from 150 to 200 pounds. This illustrates the wasteful method of harvesting now in use. As a result of his first report, the Secretary of the Interior of the Philippines, Dr. Dean C. Worcester, asserts that at the present rate of destruction there will be no gutta-percha trees standing four years hence, and he suggests that the government take over the business with the view to regulating the supply and preventing much of the cheating which is now done by the Chinese merchants. Dr. Sherman also investigated the question of rubber resources. None was found in Mindanao, but in the Sulu Islands he saw an abundance of large rubber vines or creepers, from which the rubber is extracted by cutting them so freely that they soon die. During 1901 and 1902 the exports of gutta-percha on which the duties were paid amounted to 282,996 pounds.

Rubber Production and Trade of Brazil.

The rubber-crop year for the season of 1902-3 closed June 30 under very satisfactory conditions, says K. K. Kenneday, consul at Para, under date of July 7, 1903. Estimates and preparations are now being made for the new season just begun. The crop of 1901-2 was the largest ever produced—29,998 tons. The crop of the season just closed was 29,890, a decrease of only 108 tons, or less than one per cent. This is especially satisfactory to the trade. Of last season's crop Europe took 15,261 tons and the United States 14,566 tons, an increase in shipments to the United States over the previous year of 510 tons, while the shipments to Europe fell off correspondingly.

The product was shipped as follows:

From	To Europe. Pounds.	To United States. Pounds.
Manaos	16,619 381	18,425,657
Para	13,422,609	13,686,142
Iquitos	3,57-.739	.....
Serpa	22,583	.....
Total	33,643,312	32,111,709

The stock on hand June 30 was 129 tons.

During the past year prices ruled fairly firm at good figures. The exceedingly high prices which prevailed formerly may never be restored, but producers as well as dealers find there is still a very handsome profit for them once they have accommodated themselves to the new and more healthy conditions.

Never before has so much enthusiasm been shown in the trade, and never before have so many men been employed in the business. Thousands of laborers are pouring into the forests of the interior, and thousands more will follow. New rubber fields will be opened and old ones worked with improved methods and larger forces. As an example of this the case may be quoted of one of the largest rubber producers on the Madeira, who recently informed him that he would take out this year four times as much rubber as ever before.

Business is steadily improving here. One encouraging sign of the times is the fact that several new houses are preparing to embark in the export trade. It seems safe to predict that if there are no further political troubles on the upper river, the crop of this season will be far in advance of any ever before known.

The tunnel under the Simplon Pass of the Alps is about three-quarters completed. It will be the longest tunnel in the world when finished—*viz.*, fourteen miles, or twice as long as the Mont Cenis. Ten thousand men are employed upon the work, and it is hoped that the tunnel will be ready for use in two years. A great obstacle to the prosecution of the work has been the high temperature in the centre of the bore, the men being compelled to work on short shifts, which has necessitated the employment of double gangs. The amount of water flowing out of the south end of the tunnel is fifteen thousand gallons per minute, furnishing ample power for compressing air for the drills and cooling the tunnel itself to some extent. The cost of the tunnel will be about $1,000,000 per mile.

THE COLLIERY EXHIBITION.

BY SYDNEY F. WALKER.

What probably will be the first of a succession of annual exhibitions was held at the Agricultural Hall (Islington), London, England, from June 30 to July 7, in connection with apparatus used at collieries. It should be interesting to those who contemplate supplying electrical plant to collieries, as every kind of apparatus at a colliery, requiring power, is now driven by electricity in the most up-to-date collieries.

Electricity was very well represented indeed at the Colliery Exhibition. There were about eighty exhibitors in all, and out of these nine were of electrical apparatus. Considering the large number of apparatus of all kinds that are required for colliery working, this is creditable, indeed. Mr. Arthur Koppel, who represents in London the German firm of Balche, had a very good showing of electric locomotives specially designed for collieries, with a model electric railway, in which the German arrangement of "bow" trolley was shown enabling a locomotive to shunt without its being necessary for some one to move the trolley pole from one end of the car to the other. The "bow" trolley adjusts itself, it turns over when the locomotive or car to which it is attached reverses its direction.

Messrs. John Davis & Son, of Derby, who are the English agents for the Jeffrey Manufacturing Company, of Columbus, Ohio, had a good exhibit, including the Jeffrey long wall coal-cutting machine, the Jeffrey coal heading machine, and the Jeffrey air and electric rock drills. They also exhibited the patented safety motor which Mr. Henry Davis brought out some years since in connection with Mr. Stokes, one of H. M. inspectors of mines, in which the brushes are carried inside the commutator instead of outside. The commutator is made hollow, and the brushes rub on the inner surface of the cylinder formed by the commutator segments. This apparatus has not taken on very well. Messrs. Davis also had an exhibit of electrical apparatus suitable for mining work generally.

Messrs. Siemens Brothers had a very good exhibit, consisting of a set of enclosed motors, a rock drill, mining signals, telephones and other apparatus.

Messrs. Mavor & Coulson, of Glasgow, Scotland, who are the makers of the only bar coal-cutting machine at present in use in the United Kingdom, exhibited a sample of this machine, arranged to cut at floor level, or at any height up to that of the machine itself. Messrs. Mavor & Coulson are the advocates of the concentric system of cables for mining work, the outer to be uninsulated, but this was not exhibited.

The Nuneaton Engineering Company, maker of the heading machine known as Stanley's, in which two arms, with cutters attached to the ends of a long bar, sweep out the strata in front of the machine, making a circular hole, along which the machine passes, has adapted its apparatus for driving by electricity, and a heading machine was shown at work; that is to say, merely revolving, driven by an electric motor.

Messrs. Callender had a very good exhibit also of their cables, joint boxes, etc. The cables exhibited consisted of samples of single, two-core and three-core, and their solid system, which has been so much adopted for town lighting and power work.

The other exhibits were of great interest. Messrs. Hadfield had a good exhibit of their special steel castings, and there were exhibits of coal washing and other apparatus.

Alcohol from Acetylene.

Consul J. C. Covert, at Lyons, France, gives the following as the statement of a French chemist in regard to the manufacture of alcohol from acetylene:

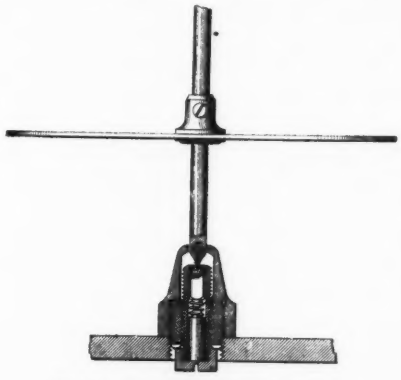
Alcohol differs but very little chemically from acetylene and ethylic differs from acetylene only by an excess of hydrogen and oxygen, acetylene being composed of carbon, oxygen and hydrogen. In his first experiments Mr. Berthelet produced acetylene, then combined it with a certain quantity of hydrogen to get the ethylene, and brought sulphuric acid to act upon the latter. He thus procured sulphorinic acid, which, well watered and boiled, produced alcohol.

Mr. Covert states further that at present calcium carbide is sold in France at $29 a ton and from this can be produced 770 pounds of acetylene, which in turn will give about 211 gallons of ninety degrees alcohol. Alcohol obtained in this way will cost about fifteen cents per gallon exclusive of incidental expenses and waste. Mr. George Claude, of Paris, a specialist in this line, estimates that the cost commercially would be about twenty-six cents per gallon. Work is now being carried out to test the suitability of barium carbide instead of calcium for this purpose, but nothing positive is yet known of the value of this material as applied in this way.

Electrical Patents.

Mr. George H. Alton, of Lynn, Mass., has assigned to the General Electric Company, of New York, a patent recently granted on a bearing for electric meters. This invention relates to a bearing for a vertical shaft, and particularly to that class known as "jewel bearings" for electric meter shafts, in which it is necessary to reduce the friction as much as possible in order that the shaft will turn in response to the slightest increase or decrease of the energy or rotate at a rate exactly proportional to the energy that is being supplied. The object of the invention is to provide a durable bearing in which there will be a minimum amount of friction, the parts of which can be adjusted and locked in any position and can be removed and replaced when they become worn. As a means of reducing friction, bearings have hitherto been constructed with the shaft tapered to a fine point, so that only this point bears upon the jewel commonly used as the bearing block; but owing to the small mass of this point, as compared with the mass of the shaft, it has been difficult to get a satisfactory degree of hardness at the point, which on this account wears away quickly. In order to overcome this difficulty, the inventor sets a piece of hard-drawn steel or fine hard wire of the kind commonly known as "piano wire" in the tapered end of the shaft to form the pivot on which the shaft revolves. These pivots can be tempered before being set in the shafts, and because of their small mass can be made much harder than a tapered point on the shaft itself. Moreover, this pivot is drawn and of a fine grain, and therefore the bearing surface can be brought to a much higher polish than would be possible if the shaft were tapered off to form the bearing. As the shaft of a meter often becomes magnetized, the pivot would stick to the shaft, rendering withdrawal difficult when the pivot becomes worn in order to replace it with a new one. Mr. Alton proposes to set the pivot in a plug of non-magnetic material, such as brass, having a tapered end and to screw this plug into the end of the shaft. Furthermore, he flattens a portion of the sides of this non-magnetic end-piece or forms a gripping face thereon in some other manner, so that with a tool of small cross-section the end-piece and the pivot inserted therein can be withdrawn through the bottom of the meter by only removing the jewel and the screw which supports it. In this way a new pivot can be substituted for one that is worn very quickly,

as it is not necessary to open the casing of the meter. After a meter has been in use some time the jewel becomes worn and rough and friction in the bearing increases accordingly. It is then necessary to put in a new jewel or repolish the old one. For this reason it is advantageous so to set the jewel that it can be easily removed. Jewels have commonly been rigidly set in the end of a screw or in a plug that rests on a spring within a hollow screw. In either of these cases it is necessary to destroy the screw to get the jewel out for repolishing. In the new device the jewel is set in a plug or jewel support that fits within a casing or carrier, preferably a hollow screw having a removable head, so that the jewel can be withdrawn by simply unscrewing the head, and a plug containing a new jewel can be substituted while the old one is being repolished. A clearance is also provided between the plug and its containing-shell to prevent dust or dirt from collecting

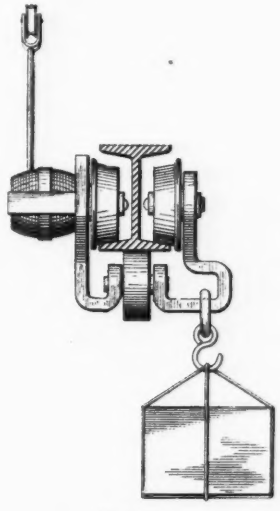


BEARING FOR ELECTRIC METERS.

about the jewel. Directly under the jewel plug and within the hollow screw is placed a spiral spring which takes up any sudden jar and protects the jewel from damage. In order to secure the proper adjustment of the bearing, the jewel is commonly mounted on a screw, as above indicated, so that the bearing can be raised or lowered to the position which allows the shaft to move most freely or to take the weight off the pivot in shipping; but Mr. Alton has found that in use the bearing of a meter frequently works up or down from the position of proper adjustment, and therefore he has provided means for locking the bearing in the desired position, thus obviating the necessity of frequent readjustment. This is accomplished by fitting the screw into an internally and externally threaded sleeve which is adjustable vertically in a threaded bore in the lower horizontal frame of the meter. The sleeve is turned in the bore until in such a position that when the head of the screw bears against its lower end the jewel bearing is in the proper position. Threaded on the sleeve and above the frame is a locking-nut, which is adapted to be screwed down until its lower end bears against the frame of the meter. Thus, movement of the screw is prevented by its head jamming against the sleeve, and movement of the sleeve is prevented by the locking-nut jamming against the frame.

An entirely new process of electroplating has been discovered and patented by Mr. Thomas A. Edison The object of the invention is to produce an adherent coating of metallic nickel or iron or steel by electrolytic deposition. The process can be carried out in connection with sheets or other blank forms, which are subsequently drawn, stamped or pressed into desired shapes, and it can also be carried out for the nickel-plating of iron and steel articles having their ultimate shape. The invention is carried into effect as follows: Iron or steel sheets or articles made from iron or steel, whether in sheet form or cast or wrought, are first electroplated with a thin coating of nickel in an ordinary electrolytic bath. The sheets or articles are then preferably piled or nested together, so as to occupy as small a space as possible, and are placed in a cast-iron chamber or clay retort, which is closely sealed. A non-oxidizing atmosphere is then created in the chamber or retort, preferably by passing hydrogen gas through the same to displace the air therein. The sheets or articles are now subjected to a temperature sufficient to weld the film of nickel to the iron or steel backing while the non-oxidizing gas is passing, after which the chamber or retort and its contents are cooled down below the oxidizing point while the articles or sheets are still surrounded by the gas, whereupon the latter may be removed and a fresh charge introduced into the chamber. The sheets or articles should be heated to a bright yellow, at which point the nickel welds to the iron or steel, so that it becomes integral with it, and at the same time the surface of the nickel becomes very bright. The weld, in fact, between the nickel and iron or steel is so perfect that sheets plated in this way can be formed into various articles by the drawing or stamping process without cracking or flaking the film, which is not the case when the film has not been subjected to the welding process. In fact, no matter how carefully sheets of iron or steel may be electroplated with nickel, any attempt to draw or stamp articles therefrom results in the cracking or flaking of the nickel coating, owing to the condition of tension of the latter, which condition is relieved by the welding process described. The welding process serves also to anneal the sheets for the first operation of drawing. It is said that nickel articles made by the process can be produced more cheaply than those made from tinned iron, since the thickness of the nickel film is very much less than the thickness of the coating on the latter articles.

Improvements are constantly being made in telphers or overhead carriages for packages. These are being employed in factories, warehouses and similar places. One of the latest improvements has been protected by a patent granted to Mr. Henry M. Harding, of New York city. It is the usual custom to have the electric motors placed on one side only of the carriage on account of the limited space



TELPHER.

in which switches and turnouts can be placed. Two motors are used coupled together and the weight of these motors would cause the carriage to tilt were not means taken to prevent this. The track is an I-beam, the motor having wheels that are beveled and engage the offset flanges of the beam. In the present case, the wheels on one side are attached to axles which constitute the motor shafts, and said wheels are secured to a stirrup which passes beneath the I-beam. A guide or friction wheel is journaled on this stirrup and runs under face of the I-beam, this friction wheel being vertically adjustable if desired. The stirrup is provided on the side opposite the motors with an offset portion extending beyond the wheel, and from this offset portion is suspended the package carrier that thus counterbalances the motors and prevents any undue strain upon the telpher.

Reviews of Current Engineering and Scientific Literature.

Some Substation Dangers and Their Prevention.

In this communication some dangers existing in the usual substation are pointed out, and remedies suggested. One danger is that due to the sparking of the synchronous converters. This is caused largely by the lubrication on the commutator, and the author states that he has not found it necessary to lubricate the commutator if the brushes receive careful attention. The terminals of the machine should be covered to prevent contact with tools. Brush-holders should be so constructed that the brushes on the slip-rings can have their pressure regulated by an easy get-at-able screw. He has seen short-circuits occur due to the metal bolt-heads used in assembling the switchboard panels, and advises that these be enclosed in ebonite or other insulating material susceptible of a good finish. The boosters should be arranged so that when not in use they are not connected to a live circuit. Attention should be given to the construction of circuit-breakers to prevent the flying out of the carbon tips when opening. The station attendant should be cautioned against touching the voltmeters except when absolutely necessary.—*Abstracted from the Electrical Review* (*London*).

The Garuti Process for the Industrial Electrolysis of Water.

The industrial electrolysis of water necessitates the solution of two problems, that of reducing the electromotive force required to a minimum and the prevention of mixing of the two gases. M. M. Jottrand, in this article, describes the process developed by Garuti. In order to diminish the electromotive force, it is necessary that the electrodes be brought as close together as possible and that they must be separated by a substance, which, while impermeable to the gas, will not prevent the flow of current and the circulation of the electrolyte. To reduce the resistance of the electrolyte sulphuric acid or a caustic alkali may be used. The most satisfactory material for the diaphragm has been found to be a metal material peforated by small holes which, due to the capillary action of the electrolyte, prevent the passage of the gases. The material selected is lead if the sulphuric acid is used and iron if the caustic solution is used. The apparatus consists of a series of compartments side by side, each compartment enclosing one electrode. These are alternately positive and negative and in the upper part the alternate cells are connected together. In this way oxygen in a practically pure condition is obtained in one set of cells and hydrogen in the other. The output of the apparatus is 0.4 cubic metre of hydrogen and 0.2 cubic metre of oxygen per ampere-hour at a voltage of from 2 to 2.5. The gas obtained in this way is cheap, and this makes it suitable for a great number of operations. Sheets of metal may be welded together or welded into pipes. After welding a milder heating may be applied to leave the metal in a good condition. It is stated that copper bonds are in this way easily welded to the tramway rails, thus doing away with drilling, and that even the rails themselves may be welded together.—*Translated and abstracted from Revue de L'Electricite* (*Berne*), *July* 15.

Natural Sources of Energy.

In this article Dr. Louis Bell gives an interesting and suggestive view of our available sources of power. He lays stress upon the wasteful use of coal which is now going on. The practical problem that presents itself to the student in economics is, first, how to make the most of the fuel that remains, and second, how to supplement it so as to increase the area of the earth's surface which will remain tenable when the fuel supply fails. The first end is to be reached by deliberate and persistent efforts to increase the efficiency with which fuel is utilized. In spite of every effort of this sort, we are consuming much coal at a rate which will steadily increase, in spite of every effort and improvement. Hence, it is necessary to seek out other means for obtaining power and heat. The first recourse is to water power. Falls like Niagara are quite insignificant features of the world's total power, the bulk of which is in small falls. Every one of these, properly utilized, stops a call for fuel. All the electrical transmission yet accomplished is but a drop in the bucket. Nothing but the dire stress of rising prices of fuel will force enough capital into hydraulic plants to produce a perceptible effect. The difficulty in the use of tides is that the total rise and fall is comparatively small. In very few places would it be possible to rely on more than six feet mean working head. This means that if a storage pond were six feet and one mile square, it would store water to about 5,000 horse-power for a five-hour run. In special cases, while the rising is higher the output would be greater, thus, in the Bay of Fundy more than 200,000,000 horse-power-hours run daily to waste, but to utilize it would require an engineering feat more tremendous than anything yet attempted. The utilization of wind-power is less attractive than that of tidal-power, since the supply is erratic and variable. A possible remaining source is the heat from the sun. This is reckoned at about 10,000 horse-power per acre. From practical results it has been possible to obtain one horse-power for every 100 feet of reflector used in these solar engines, but these are only valuable where there is reasonable steady sunshine. The cost of power so obtained is estimated at about $75 per horse-power per year, including everything. There are large tracts of territory where sun-power would be available, notably in northern Africa. The author thinks eventually when the coal supply has been exhausted, migration will take place toward warmer regions, laying principally between altitudes thirty degrees north and south. Here all ordinary domestic needs are satisfied, where sunshine is available and the demands of power-using industries can be readily met, where hydraulic power is available or by solar power in the sunshine.—*Abstracted from Cassier's Magazine, August.*

A Spectrophotometric Study of the Luminous Radiation from the Nernst Lamp Glower Under Varying Current Density.

This article gives an account of an interesting study carried out by Mr. Leon W. Hartman upon the luminous regulation of the Nernst lamp glower. The Nernst lamp glower has been studied in many aspects, but this particular phase has not been touched upon. The work was carried out with a Kirchhoff spectrometer especially set up for the work and which had a Rowland plane grating substituted for the train of glass prisms. The standard source of light used was an acetylene flame burning under constant pressure in a Naphey burner. The type of Nernst lamp glower used was that for 104 volts alternating current. To convert to known values the results obtained by the use of the acetylene flame, the latter was

compared with the Hefner-Altneck standard lamp. Results of the work are tabulated and given in a number of diagrams. The work is summarized as follows: At the normal current strength the radiation from the Nernst lamp glower is relatively rich in the more luminous waves of the spectrum, and it exhibits no marked selective radiation, its light intensity apparently increasing with age; its light is relatively less in the short, but richer in the long, waves than that from the acetylene flame, but its radiation becomes more like that from burning acetylene with increasing current strength; at current strength below the rated normal value, the increase in intensity with increasing current strength is most marked in the long waves, and above this rated normal value current strength the increase in intensity is most rapid in the short waves, at current strengths below the normal value the Nernst lamp is relatively less rich in the short waves than the flame of the Hefner lamp, while above this current strength the opposite is true; at rated normal current strength or slightly above this the color of the Nernst lamp radiation is very similar to that of the Hefner lamp. The luminous radiation from the Nernst lamp corresponds very closely to that of incandescent old lime.—*Abstracted from the Physical Review (New York), August.*

The Utilization of Furnace Gases for the Production of Electrical Energy.

During the last few years the progress made and the success of gas engines as applied to automobiles have drawn attention to this type of motor for more serious work. In this article, M. L. Drin discusses the use in gas engines of the waste gases from blast furnaces. The first practical gas engine dates from 1870. For many years their power was limited to twenty horse-power, but to-day gas engines are constructed with outputs of 4,000 and even 5,000 horse-power. At the same time that the size of these motors has been increased, tests have been made with the view to using in these engines a poorer quality of gas. Thus, in 1886, instead of illuminating gas containing from 4,500 to 5,000 calories per cubic metre, Domon gas was substituted, which contains from 1,000 to 1,500 calories per cubic metre, and this allowed the consumption of gas per horse-power-hour in machines with a capacity of 2,000 horse-power to be reduced to one-half kilogramme. The success of these machines has led to the introduction of gas engines to utilize furnace gases. This gas was formerly allowed to go to waste. More recently it has been used to heat the air for the blast and to raise steam for power purposes. This gas is poor, containing only about 1,000 calories, so that its use necessitates large engines. Generally it is necessary to cleanse the gas before use, but this is accomplished simply by passing it through one or more circulating fans where it is washed by a spray of water. This removes practically all the dust. The method of utilizing this gas in engines is discussed briefly. It is stated that builders have, in some cases, secured such a uniformity of rotation that alternators driven by their engines are now operating successfully in parallel with steam-driven units. Economy in the use of gases is considerable. For every ton of blast produced daily 2,400 cubic metres of gas are set free. This volume of gas used under boilers can develop but twelve horse-power, but if used in gas engines it will develop thirty-two horse-power, there is, therefore, available 2,000 horse-power if the daily output of the furnace is 100 tons, this is 3,500 kilowatt-hours per day, which sold at four centimes will give an income of 550,000 francs per year, sufficient to pay all expenses and yield a large profit. This application of the gas engine is being made particularly in Germany and the Grand Duchy of Luxembourg. At the latter place there is a station at Differdange, consisting of six gas engines of 600 horse-power each, and three generators of the same capacity, which generate and transmit power from the furnace to the surrounding country.—*Translated and abstracted from La Revue Practique de L'Electricite (Paris), July 20.*

The Cost of Electric Drilling.

In his annual report, Mr. J. B. Hobson, general manager of the Consolidated Cariboo Hydraulic Company at Bullion, B. C., gives some interesting figures of operating and installing electric drills. The plant is an experimental one and included four Gardner No. 15 drills with two-horse-power, 110-volt, direct-current portable motors, and one Gardner "B" drill with one and one-half horse-power, 110-volt, direct-current portable motor all complete.

The apparatus is able to drill holes eight feet deep. The cost of fuel for running drills ten hours was $2.25, lubricants for machinery thirty-five cents, and engineers' wages $4, making the total cost of power $6.60. To operate the three drills, three drillmen at $4 a day each are required, with three helpers each at $2 a day, one blacksmith at $4, one helper at $2, charcoal and lubricants ninety-five cents, making the total cost of running the three drills for ten hours $31.55.

The work done by these drills averages 312 feet of holes in ten hours. The cost of the same work performed by hand drills is stated at $91, making a saving in favor of power drills of $50.45 for the ten hours.

BOOK REVIEW.

"Electrical Influence Machines." John Gray. New York. D. Van Nostrand Company. Cloth. 296 pages. 5½ by 7 inches. 105 illustrations. Second edition. Supplied by the ELECTRICAL REVIEW at $2.00.

This book purports to bring together, in one volume, all that is useful and interesting about influence machines. The subject is treated in three parts. The first part gives an outline of the elements of static electricity in such a form as to be understood by general readers. Besides the material which is to be found in all ordinary books upon the subject, there is an admirable presentation, in popular language, of the most recent views of the electron theory, of the Zeeman effect, and of the extensive work of J. J. Thomson. The second part consists of a review of the historical development of the influence machine, commencing with the electrophorus. The works of Varley, Toepler, Holtz, Wimshurst, Kelvin and Pidgeon are described in considerable detail. The third part gives the details of construction and hints as to the care and operation of modern Holtz, Wimshurst and Voss machines. There is no description of the very excellent machines which are manufactured in the United States and no notice is taken of them except in the preface, where they are termed "only good practical modifications of the older types." As a matter of fact, these machines are far superior to those mentioned in the book. The giant Toepler, with sixty rotating plates, is mentioned, on page 38, as developing 100,000 volts. Standard American machines with ten plates, such as are commonly used in electrotherapeutics, develop as much as 600,000 volts. In the preface occurs the statement "the practical efficiency of the influence machine is only about five to ten per cent." Experiments made by the reviewer on American ten-plate machines have shown, when the electrical output was measured, an efficiency as high as twenty-seven per cent, and when one machine was run as a motor by a similar machine and when the power of the motor was measured by a strap brake, an efficiency of more than twenty per cent was found on a very humid summer's day. The book will be found of great value to those who are interested in the construction or operation of these interesting machines. There are a great number of results of fruitless experiments, made by early workers in this field, which are mentioned and which will tend to save others the expense of repetition.

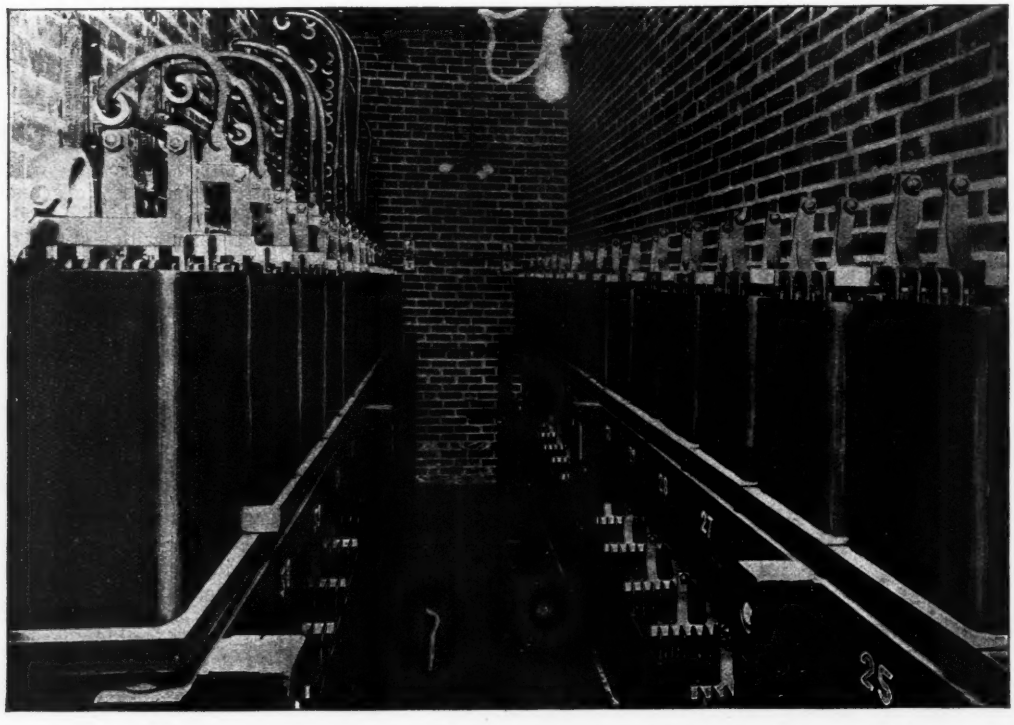
INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Storage Battery Equipment in a Large St. Louis Dry Goods Company's Building.

The accompanying illustration shows the storage battery room, which is an important part of the power plant installed for the Ferguson McKinney Dry Goods Company, St. Louis, Mo.

In designing this installation it was realized that the severe elevator service, particularly the starting and stopping of well loaded cars, and the returning of current to the line under certain conditions, would make it difficult to regulate the voltage and that the fluctuations in the arc and incandescent lamps would probably be serious. A storage battery was realized as a desirable addition to the installation as it would ensure uniform voltage, prevent flickering and permit the use of high-efficiency lamps. It would also enable the size of a reserve unit to be decreased and furnish a reasonable amount of light and elevator service outside of working hours, carry the regular load during short interruptions of the generating plant, give the engine more uniform and economical load, and make it unnecessary to have any gas in the building. The contract of this storage battery was filled by the Electric Storage Battery Company, of Philadelphia, consisting of a battery of seventy-two elements of the latest type of chloride accumulator, each element to contain fifteen type-F plates, to have a capacity of seventy amperes for seven hours; ninety amperes for five hours ; 130 amperes for three hours, and 280 amperes for one hour. This contract included two additional switchboard panels, with the necessary instruments and switches, consisting of voltmeters, ammeters, circuit-breakers, rheostat, end-cell switch, and a motor-booster of a capacity of 220 amperes at twenty-five volts. In the battery room there are two rows of cells on each side of the passageway, one above the other. The room is ventilated with a flue running from the south end along the ceiling.



STORAGE BATTERY ROOM, ST. LOUIS DRY GOODS COMPANY'S PLANT.

Electrical Developments in Spain.

During recent years there has been a rapid development in electric railways in Spain. The present systems include 200 English miles, distributed throughout the various provinces. There is also an active development going on in the utilization of water power. In the district of Barcelona alone there are 800 turbines with an aggregate output of 25,000 horse-power. Many towns are adopting electric lights which heretofore have been lighted by oil.

FIG. 1.—SPHERICAL COIL WATTMETER.

Switchboard Indicating Instruments.

The spherical coil wattmeter shown in Fig. 1, manufactured by the Stanley Electric Manufacturing Company, of Pittsfield, Mass., is constructed upon the dynamometer principle. A movable coil attached to the pointer is suspended within the field of a fixed coil. The fixed coil carries the main current of the circuit and through the movable coil the pressure is taken. The winding of the fixed coil is of a hollow, spherical form, from which the instrument takes its name. The movable coil and pointer are delicately suspended in jeweled bearings and their motions are dampened by an air dash-pot, making the instrument dead-beat. It is not affected by frequency or wave-form, nor by inductive nor leading loads of any power-factor. This instrument has a resistance of approximately thirty ohms per volt in the pressure circuit. Station instruments of 150 amperes or less capacity and for use on circuits of less than 3,000 volts have the resistance

self-contained in their cases and the total current is introduced into the fixed coil. With instruments of a greater capacity or for use on circuits of a higher voltage than this series transformers are regularly used. If instead of the instrument taking the total current through its fixed coil the series transformer is used it must be calibrated on the frequency for which it is intended, as the introduction of a series transformer makes the instrument subject to slight frequency errors.

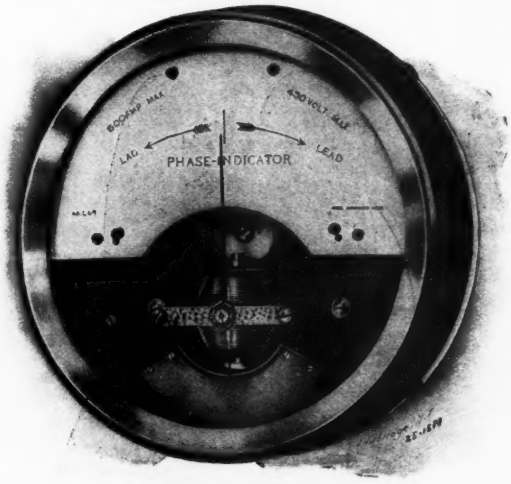


FIG. 2.—PHASE INDICATOR.

Fig. 2 shows a phase indicator manufactured by the Stanley company. This indicator gives correctly the condition of the phase relation of current and the electromotive force of its circuit. The pointer deflects to the left if the current lags behind the electromotive force, remains at zero when the current is in phase, and deflects to the right if the current leads the electromotive force. For stations where motors are being run from the same machines which supply the lighting load it is obvious that such an instrument is of great value, as by its indications the point of proper excitation of the synchronous motors is quickly and exactly determined, and the regulation of the whole system materially increased.

This phase indicating instrument is a modified spherical-coil wattmeter, having its zero in the centre. Two arrows, pointing respectively to the right and left, take the place of the wattmeter scale. The instrument depends for its action upon the principle that no force is exerted between two coils carrying currents ninety degrees apart, hence if a wattmeter is taken and a current is introduced in its fixed or series coils and through its movable or pressure coil another current is introduced differing in phase to the series current by ninety degrees the pointer will stay at zero. If, however, the current in the series coil should change its phase relation to that in the pressure coil by more than ninety degrees the pointer would deflect to the left, indicating a lag. If less than ninety degrees a deflection to the right would result, indicating a lead.

Fig. 3 shows a static ground detector made by the Stanley company. These static-current detectors are made for voltages from 600 up.

The instrument case is entirely of hard rubber moulded to the required form. Inside the case four fixed vanes are arranged around a movable vane. The movable vane is made of aluminum, is carried on a jeweled bearing and attached to the pointer. The fixed vanes are connected diagonally in pairs and each pair is charged statically by one of the line wires through the medium of a condenser. When the condensers are independent of the instrument they are generally mounted behind the switchboard. The instrument has three binding-posts, from which connection studs extend back and serve to support it on the marble. The binding-posts at the sides of each connect a pair of fixed vanes with the secondary of one of the condensers. The lower binding-post serves to connect the movable vane to the earth. The movable vane is acted upon inductively by the fixed vane so that the stress produced by each pair is equal but opposite. The movable vane in consequence takes a position equally between the fixed vane, which position is the same whether the instrument is charged or not, and the pointer stays at zero, indicating no ground.

FIG. 3.—STATIC GROUND DETECTOR.

If, however, the primary plate of one of the condensers and the movable vane becomes electrically connected, as happens in the event of a ground, immediately the pair of fixed vanes which lead to that condenser assume a like polarity with the movable vane and the latter is repelled. At the same time the action of the other fixed vane is to attract. The two forces acting in the same direction, the movable vane takes a position entirely within the vanes oppositely charged to it, and the pointer takes a position indicating ground on the side of its deflection.

Fig. 4 shows the static voltmeter manufactured by this company. The movable vane is mounted on knife-edged jewels and its movement is controlled by a spring, the movable parts are carefully balanced so that slight changes from the perpendicular do not affect the readings of the instrument. The fixed vanes are imbedded in hard rubber. This covering of hard rubber confines the charge and prevents it from leaking through to the other parts of the instrument. Two fans are attached to the pointer and are enclosed in the damping boxes shown in the lower part of the illustration, making the instrument dead-beat. All the working parts are mounted on hard rubber, securing the highest insulation.

These instruments are carried in stock for use on 1,000 to 3,000-volt circuits.

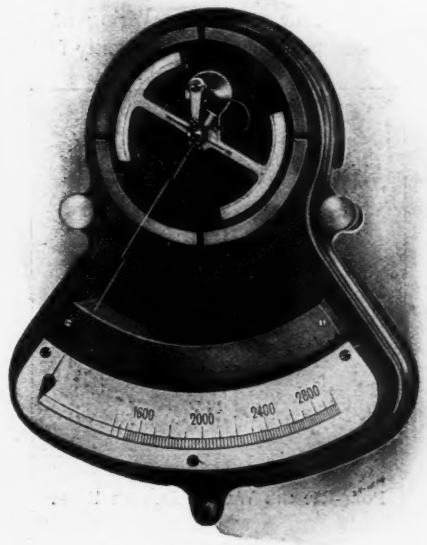


FIG. 4.—STATIC VOLTMETER.

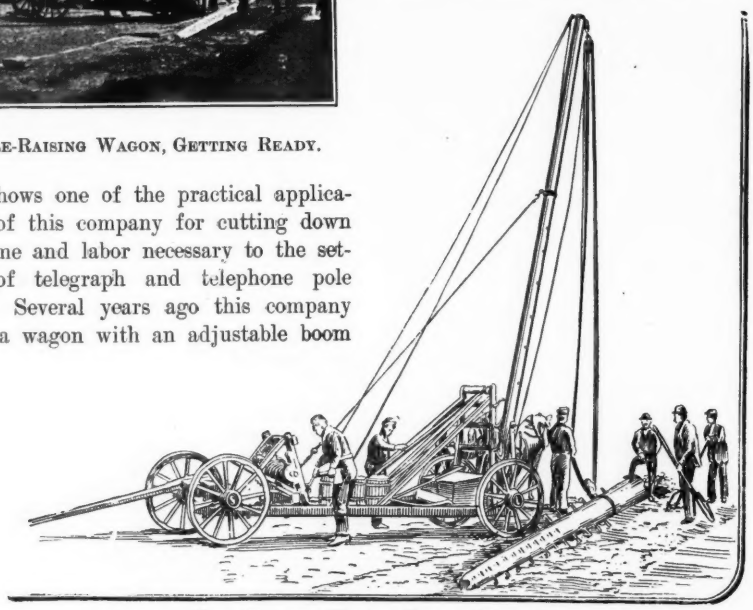
The scale of the 1,000-volt instruments ranges from 750 to 1,400 volts, and the scale of the 3,000-volt instruments from 1,400 to 3,8000 volts.

Pole-Raising Wagon and Construction Apparatus.

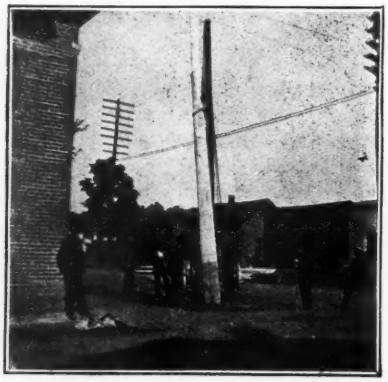
Messrs. W. H. Anderson & Sons, of Detroit, Mich., are the manufacturers of a line of construction tools of every description. The accompanying illustration shows one of the practical applications of this company for cutting down the time and labor necessary to the setting of telegraph and telephone pole lines. Several years ago this company fitted a wagon with an adjustable boom or derrick, by which the lifting of the poles into position would be greatly facilitated. Many improvements in the details of construction since building the first wagon have been made, and the company now furnish an apparatus which they claim is one of the best and most economical for the setting of poles. The wagon is composed of an extra heavy drop-platform truck, upon the rear of which is placed a trunnion supporting an extension arm or boom. This boom is made of steel tubing, with a hardwood spar inserted, which is so fitted that it can easily be set or extended to any desired length suitable to lift telephone and telegraph poles from thirty-five feet to seventy feet long. On the front end of the wagon is mounted a hoisting winch which operates the guy line supporting the boom, so arranged that the boom can be moved to any desired angle, even when the load is in suspension. The boom is fitted with suitable tackle, and this is so arranged that the team which hauls the wagon is used, by means of a snatch block, to raise the pole into place. It is not necessary for the team to be hitched to the wagon to move from pole to pole, for arrangements are made whereby the team is hitched to the rear end, and one of the crew taking hold of the wagon tongue steers the wagon to the desired location, while the team pulls it along.

The wagon also contains a tool box suitable for holding pole rings, steps, washers and the small tools which are always necessary to pole-raising crews.

POLE-RAISING WAGON, GETTING READY.

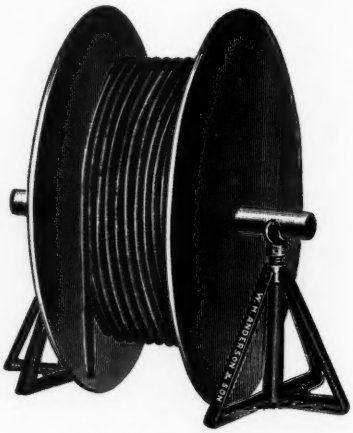


POLE-RAISING WAGON, TAKING HOLD.



POLE-RAISING WAGON, LIFTING POLE.

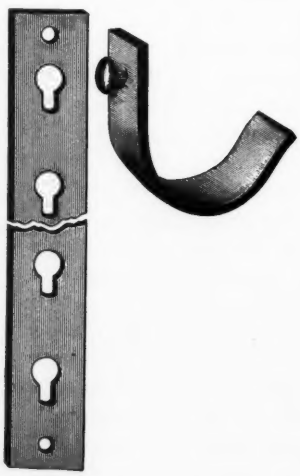
POLE-RAISING WAGON, LANDING POLE.



CABLE REEL JACK.

The cable reel jack shown in the illustration is made in two styles, one with a heavy angle iron frame and steel screw, capable of handling the heaviest reels of underground cable. In the other the body is made of cast steel with a machinery steel screw, capable of handling reels up to four feet six inches in diameter.

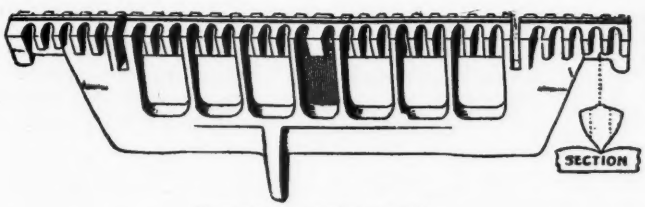
The manhole cable hanger shown in the accompanying illustration is of an improved design, and can be easily attached to the side of the manhole to carry the cables. The strip is attached to the manhole by means of an expansion bolt at the top and bottom, and eliminates the necessity of building in pieces of pipe or rod. The hook is easily attached by inserting the button head into the hole on a level with the conduit in which the cable is laid. The strips are made of any desired length suitable for two to ten hooks. The holes are punched the same distance apart as the conduits are laid.



MANHOLE CABLE HANGER.

A New Form of Grate.

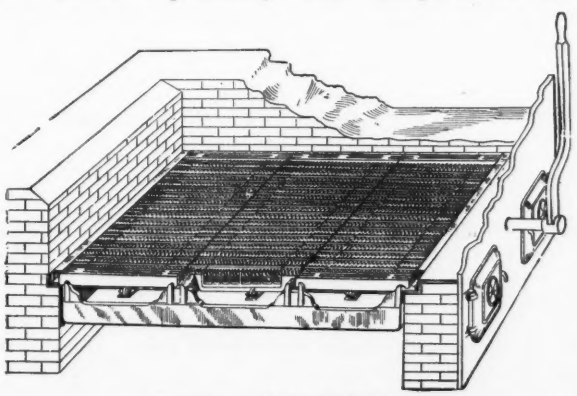
One of the most serious objections to the ordinary form of furnace grate is the difficulty which is experienced in burning any other than a high grade of fuel. A large proportion of the coal from our western mines is what is known as slack and screenings, this grade of coal not being as salable as lump or mine run is sold at a much less price per ton. The recent improvement made in grate construction and the developments in rocking or shaking grates have made a great deal of this



FORMATION OF GRATE BARS.

hitherto objectionable form of fuel quite practicable.

The Martin Grate Company has developed a form of rocking grate which is claimed to have especial merit in this direction. The grate bars extend lengthwise of the furnace and the service grate is as small as a plain grate. The grate bar is only one and one-half inches wide, including teeth, and is about five and one-half inches deep, and as they will rock in the same direction and at the same time the spaces between are not enlarged and it is not possible for a clinker to drop between and clog the grate, obviating the difficulty of leaving fingers sticking up which may be burnt off in a hot fire or presenting



SECTIONAL VIEW OF GRATE.

irregularities which might interfere with the manipulation of a slice bar.

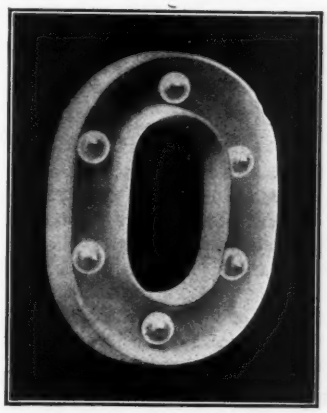
This grate is one of the heaviest on the market, weighing about eighty pounds to the square foot. The heavy part of the grate bar is quite a distance below the fire line and does not become hot. This fact, with the free circulation of air through the grate bars horizontally, and the slot at the ends, allowing for expansion and contraction, gives this grate considerable durability.

The grate bars rest like an inverted cone on the bearing bars, making the operation of the grate almost frictionless. A number of testimonials have been received by the company commendatory of the excellent service which these grates have given. The Martin Grate Company has its headquarters at 85 Van Buren street, Chicago, Ill.

An Attractive Electric Sign.

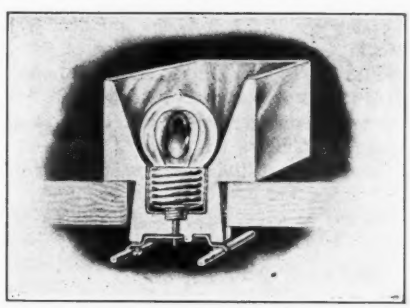
The accompanying illustrations show a form of electric sign which possesses a number of features of more than usual merit. The Colonial Sign Company, of Akron, Ohio, is the manufacturer of this apparatus and the aim in its design has been to provide an electric sign that would not blur at a distance, would retain its color, would be attractive by daylight, water-proof, and one that would not cost much to operate.

In making up these signs the letters are manufactured of a vitreous china, which takes on a brilliant hard glaze. The company is making several sizes of letters and it is its intention to build these letters up to heights reaching some ten feet. The porcelain from which these letters are made is not affected by heat, moisture or the action of electrical current. Except for the renewal of lamps the sign has an indefinite life. The letters may be shaded in any color desired, or made pure white. The colors are burned into the china and are permanent. The letters and sockets are composed of one continuous piece of porcelain and there is no material of a combustible nature used in the construction which comes anywhere near to the lamp or wiring. If these signs become dirty through exposure to the elements they can be washed. The patent for this sign covers a concave letter of such form that it will reflect the light in parallel rays, enabling the sign to be read at a great distance and at almost any angle. The design is such that it will give a high illuminating effect with



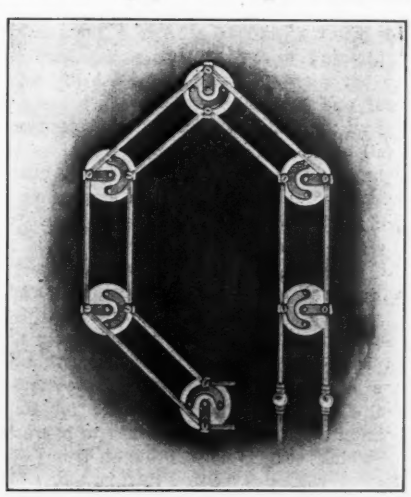
ELECTRIC SIGN LETTER.

a small amount of light, reducing the number of lamps and the candle-power of each, at the same time producing a bright, sharply defined letter.



CONSTRUCTION OF LETTER.

The Colonial Sign Company is about to occupy a large new factory at South Akron, Ohio. This will enable it to handle a largely increasing business and



WIRING OF SIGN LETTER.

give it facilities for manufacturing other specialties in this line. H. B. Camp is president of the company; G. P. Good, vice-president; C. R. Quinn, secretary; J. E. Good, treasurer, and G. D. Chapman, general manager.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

ELECTRIC COMPANIES AT ALTON, ILL., TO MERGE—The Alton Railway, Gas and Electric Company, owning and controlling the Alton street railway, gas and electric plants, will have a capital stock of $1,000,000. The Alton & East Alton Railway and Power Company, owning the projected line to East Alton and all franchises pertaining thereto, is to be merged with the older company. The consolidation is for the purpose of carrying out some big projects the Alton company has on hand, including an extension of the East Alton line to East St. Louis and the building of additional electric lines in Alton.

MR. AUGUST BELMONT AFTER LONG ISLAND ELECTRIC —Negotiations are said to be under way between the Belmont syndicate which purchased the New York & Queens County Railway system, President Porter and the other Philadelphia capitalists in control of the Long Island Electric Railroad. President Porter has been over the line with the intending buyers at different times during the past week, and it is said that although the parties are $200,000 apart at present the gap will grow considerably smaller before the summer is over. The Long Island Electric line is about eight miles in length between Jamaica and Far Rockaway, five miles between Jamaica and the terminus of the Kings County Elevated Railroad at Crescent street and Liberty avenue, and three and one-half miles between Grand street, in the village of Jamaica and Queens, and work is now under way for the extension of the line over the Jamaica and Hempstead turnpike along the front of big Belmont Park race tracks, where $2,000,000 is being expended in making one of the greatest racing parks in the country.

GREAT NORTHERN POWER COMPANY, DULUTH, MINN.—Dynamos of 10,000 horse-power, with a twenty-five per cent overload, operated by water-wheels of 12,500 horse-power, is what, it is stated, the Great Northern Power Company, of Duluth, is preparing to install. Three or four of these machines will be the initial installation, to be followed by others as power consumers require, till 150,000 horse-power available is utilized. The scheme is one of the largest under way in this country, and is all ready for the contractors. Preliminary engineering work has been under way for more than two years and the plan has been inspected by many of the foremost electrical and hydraulic engineers of this country and Europe, who pronounce it simple, feasible and of great economic possibilities. A fall of more than 350 feet, vertical, is secured above the wheels, by bringing the water down a steep hill in a pipe. Slight dams for storage, a canal two miles long, a steel gravity dam forty feet high, lead to the pipe. Below the waste weir are rapids and in a mile or more of distance is an additional fall of seventy feet. This will be used for direct hydraulic power by another steel dam, and several mills, requiring much water direct, will be located there. The main power plant, above, will furnish energy for many industries at Duluth, and probably for a score of iron mines on the Mesaba range. It is reported that preliminary negotiations have been in progress between the company and the United States Steel Corporation for this power for its mines. The Steel Corporation alone has twenty mines in operation on the Mesaba range, for which coal is now brought from Ohio. Electrochemical industries will also utilize this power, which is to be brought by wire into a transforming and transmitting station at Duluth. This distance is but ten miles, while to the most distant Mesaba mines it is only sixty miles from the power plant. Pulp and paper mills will use the direct hydraulic power at the lower dam. This company has been financed in Chicago and one eastern city outside New York. Its plans call for an expenditure of about $3,500,000 for the installation now contemplated, and an ultimate cost much greater. Much of the power to be developed has already been sold under long-time contracts.

PERSONAL MENTION.

MR. GEORGE P. ROUX, of Havana, Cuba, a well-known electrical engineer, is in the United States and will make his headquarters at Ardmore, Pa., for a time.

MR. E. D. NELSON, who has served as superintendent of motive power for the Pennsylvania Railroad at Williamsport, Pa., will make his headquarters at Altoona, where he will at once begin his new duties as superintendent of mechanical and electrical tests.

MR. HUGH L. COOPER, of New York, special consulting engineer of the Montreal Light, Heat and Power Company, has left for Winnipeg at the request of Messrs. Mackenzie & Maner, to superintend the installation of the plant of the Winnipeg Power Company.

PRIVY COUNCILLOR RATHENAU, one of the leading men in electrical interests in Germany and managing director of the Allegemeine Elektricitäts, of Berlin, is to visit the United States soon. He will study electrical progress here, and probably negotiate with some of our largest electrical manufacturers.

MR. J. S. BADGER, general manager of the Brisbane-Queensland electric traction system, is now in the United States, and will sail soon for England for the purpose of conferring with the directors of the Brisbane Tramways Company, Limited, which company operates the road and whose headquarters are in London. He will return to Australia *via* the States.

MR. J. A. BUCKNELL, for the past four years local agent at Jackson, Mich., for the Grand Trunk Railway, has resigned this position to take the newly created post of general freight and passenger agent of the Jackson & Battle Creek Traction Company. This company is a consolidation of the Jackson-Albion-Calhoun Railway, and the Marshall & Battle Creek Railway.

MR. CHARLES E. PHELPS, of Baltimore, Md., consulting engineer for underground work at Cleveland, Ohio, and Johnstown, Pa., is busy with plans for the underground system of subways for Montreal, Canada. Mr. Phelps has had a great deal of experience in subway work and is well qualified to equip Montreal with a first-class system of conduits. He is still in charge of the municipal subway system at Baltimore, Md., where several million duct feet of conduit is being installed.

MR. THOMAS M. MOORE, chief, department of machinery, World's Fair, St. Louis, Mo., is visiting the eastern states. The outlook for a most remarkable machinery exhibit is very positive and the only concern now is for to find room for all applicants. This is all the more remarkable when the extent of the space allotted to this department is realized. The foreign exhibit will be especially interesting. Lieutenant Godfrey L. Carden, R. C. S., who recently made an extended tour in Great Britain and on the Continent in the interest of this department, is enthusiastic over the splendid spirit with which the foreign manufacturers are taking hold of the exhibit idea.

MR. WILLIAM PASTELL has resigned his position as superintendent of motive power of the Worcester Consolidated Street Railway Company, and will join the railway engineering staff of Messrs. J. G. White & Company. Mr. Pastell is one of the best-known electric railway engineers in New England, and possesses wide experience in this field of engineering. He was assistant engineer to the Lynn & Boston Railroad from 1893 until 1899, when he became its chief engineer. He held this position until May, 1901, when he resigned to take the one he is just leaving in Worcester. During his two years in Worcester, Mr. Pastell has effected marked improvement in the physical condition of its railway property. Mr. Pastel is perhaps the best-posted engineer in the country on the subject of signals for electric railways.

ELECTRIC RAILWAYS.

AUGUSTA, ME.—It is stated that an electric road will be built to connect Oakland and this city. The proposed route is eighteen miles in length.

DES MOINES, IOWA—It is reported that eastern capitalists will build an electric road from Independence to Quasqueton, at a cost of $200,000.

GRAND RAPIDS, MICH.—It is stated that an electric line is proposed to run from Grand Rapids to Muir, Hubbardston, Carson and Ionia, terminating at Crystal Lake. The cost of the road is estimated at $230,000.

PHILADELPHIA, PA.—Work has been begun on an electric railway to run from Christiansburg on the Norfolk & Western main line to the United States arsenic mines in Floyd County, Virginia, a distance of twenty miles. The road will cost $700,000.

PITTSBURG, PA.—It is stated that the Pittsburg Railways Company will build a line extending from Trafford City to Larimer, Irwin, Jeannette and Manor. The right of way has been secured and it is hoped to have the road completed by early fall.

REYNOLDSVILLE, PA.—The Jefferson Traction Company has obtained the necessary privileges to build its road through Prescottville and thence to Soldier and Sykesville, and will at once begin work. Another line will extend from Sykesville to DuBois.

BELTON, TEX.—The city council has granted a franchise to W. H. Taylor, W. R. Barefoot, H. P. Kulp, W. E. Davis and J. H. Hauser, of Pennsylvania, to build a street railway and interurban road between Belton and Temple. Work is to commence within six months.

DAVENPORT, IOWA—The Davenport & Clinton Traction Company has been incorporated with a capital stock of $500,000, with the privilege of increasing to $3,000,000. Ulysses D. Eddy, president of Flint, Eddy & Company, of New York, will be president of the company.

ITHACA, N. Y.—It is reported that two companies have under consideration the matter of connecting Auburn and Ithaca by trolley. The first road will run over the line formerly occupied by the Auburn, Ithaca & Western Railway Company, while the other will be further to the eastward.

FOND DU LAC, WIS.—Surveys have been started on a proposed electric railroad from this city to Ripton and Green Lake. The proposed road will be twenty-seven miles long and will pass through a thickly settled farming country. A road is also contemplated to Milwaukee, by way of West Bend.

SCRANTON, PA.—It is stated that another trackless trolley is projected to run from Buttermilk Falls, on the Lehigh Valley Road, by way of Lake Winola to Factoryville, a distance of about nine miles. The projectors of the plan have arranged to obtain the necessary power by erecting a power-house at the falls.

CHARLESTON, W. VA.—The Ohio Valley Street Railway Company, of Chester, W. Va., has been incorporated to construct and operate a railroad from Wellsburg to Hollidays Cove, thence to New Cumberland, to Chester, thence over a bridge across the Ohio River to East Liverpool. The capital stock is $25,000.

HAGERSTOWN, MD.—The Hagerstown Street Railway Company will extend its system from Boonsboro to Myersville, to connect with the Frederick road. The extension will cost at the rate of $10,000 a mile, or $50,000. Part of the right of way has been secured, but it is probable that work will not commence until next year.

COLUMBUS, OHIO—The Scioto Valley Traction Company, with headquarters in this city, has filed articles with the Secretary of State increasing its capital stock from $1,000,000 to $3,000,000. The Lebanon & Franklin Traction Company, with its principal offices at Dayton, has also increased its capital stock from $10,000 to $160,000.

MARLBORO, MASS.—The Marlboro Street Railway, with cars and equipment, was sold at auction recently to William A. Quigley, of Boston, for $102,775. Mr. Quigley represented the Boston & Worcester Electric Company. The sale was the result of an order issued by the courts, and was conducted by George W. Estabrook, the receiver.

CUMBERLAND, MD.—The Frostburg & State Line Electric Railway, Light and Power Company has been incorporated with a capital of $120,000, to build an electric road from Frostburg to the Pennsylvania line, six miles, to connect with the Meyersdale and Salisbury line, now building. It is part of the system to connect Cumberland and Johnstown.

LINCOLN, NEB.—Articles of incorporation for the Sioux City, Homer & Southern Railway Company have been filed. It is stated that Omaha, Sioux City and other capitalists are back of the project, the purpose of the company being to connect Homer with Sioux City. The capital stock is given at $500,000, with the privilege of increasing to $1,000,000.

GREENSBURG, PA.—The connection of the Pittsburg, McKeesport & Connellsville street railway between Connellsville and Uniontown, at Dunbar, has been completed and cars are now running. The entire line from Mount Pleasant to Fairchance—thirty miles in length—is now completed with the exception of the bridge between Scottdale and Everson.

NASHVILLE, TENN.—It is said that the Kentucky Traction Company, recently organized, will build an electric line from Louisville to Nashville. Connection will be made with Bowling Green, Russellville and the entire Green River section, extending as far as West Point and Leitchfield. Freight and express will be handled in addition to the regular passenger service.

LA PORTE, IND.—The Northern Indiana Traction Company, formerly the Hobart & Western, which contemplates building an electric road connecting South Bend and Valparaiso, *via* La Porte, has been granted a fifty-year franchise by the commissioners of St. Joseph County. The company must begin work within four months and have cars running before November 1, 1904.

ROCKVILLE, CT.—The officials of the Rockville, Broad Brook & East Windsor Street Railway Company, organized to build a trolley line from Rockville through Ellington and Broad Brook to Scantic, where connection will be made with the Hartford & Springfield Street Railway Company's system, have arranged for an immediate survey of the route. The line will be about ten miles in length.

BOSTON, MASS.—The Middlesex Street Railway Company proposes to build and equip a line between Billerica and Arlington Heights, the intention of the company being to operate a fast line between Boston and Lowell, connecting at Arlington Heights with the elevated and at Billerica for Lowell with an existing route. The road will run almost wholly on private land, and will be entirely enclosed. High speeds will be maintained.

PLATTSBURG, N. Y.—It is stated that an electric road is to be built through the Saranac Valley, and that it will be completed and in operation within a year. It is the intention of the promoters of the road to run it principally along the line of the old plank road from Clayburg to Plattsburg, a distance of about twenty-four miles. Starting from Plattsburg the road will touch the villages of Morrisonville, Cadyville, Saranac, Moffitsville, Redford and Clayburg.

HUNTINGTON, W. VA.—Prominent capitalists have organized a company to build a street car line from the Big Sandy River, near Kenova, to Barboursville, paralleling the line of the Camden Interstate Railway through Central City and Huntington. The new line, as projected, is eighteen miles long, but it is believed that the ultimate aim of the new company is to extend the line on to Charleston, thence to Mount Carbon, in the Kanawha coal fields, a distance of sixty miles. Senator Stephen B. Elkins and Hon. J. L. Caldwell are said to be identified with the enterprise.

PITTSBURG, PA.—A party of Pittsburg and Youngstown business men are planning a traction trunk line to connect Pittsburg with the Mahoning Valley Traction system, which they now control. Six new connecting street railways have been chartered to close a gap of twenty-one miles. They are as follows: West Side & Mahoningtown Street Railway Company, Mahoningtown & Moravia Street Railway Company, Moravia & Wampum Street Railway Company, Wampum Street Railway Company, Wampum & Hoytdale Street Railway Company, Hoytdale & Beaver Falls Street Railway Company. The new line will form a continuous system from Warren, Ohio, through Youngstown, New Castle, Beaver Falls, Coraopolis and McKees Rocks or through Allegheny to Pittsburg.

ELECTRIC LIGHTING.

JACKSON, KY.—The Jackson Electric Light and Power Company will erect a power-house in this place.

JERSEY CITY, N. J.—Work has been started on a new $60,000 power-house for the Public Service Corporation.

CLINTON, IOWA—It is stated that D. A. McKellar will construct an electric lighting system at Rock Valley.

DES MOINES, IOWA—P. K. Tyng has purchased the plant of the Valley Junction Water and Light Company for $15,953.

STAMFORD, CT.—The power plant of the Middleburg & Schoharie Light, Heat and Power Company was destroyed by fire recently.

DENVER, COL.—The Denver City Tramway Company has put in operation its new power-house. This cost $1,500,000, and is equipped with the latest types of apparatus throughout.

GREENCASTLE, PA.—The Waynesboro Electric Light and Power Company has passed into the hands of the Chambersburg, Greencastle & Waynesboro Electric Street Railway Company.

BERLIN, PA.—The borough council has decided to purchase for the city the Berlin Electric Light Company's plant for $8,800. The plant will be improved and operated by the municipality.

CONCORD, N. H.—The plant of the Laconia Electric Lighting Company, at Lakeport, will be rebuilt, and a new plant will be erected at East Tilton by the Winnipesaukee Gas and Electric Company.

PORTLAND, ORE.—The Puget Sound Power Company, which is constructing a large power plant at Election, in Pierce County, Wash., has bonded its properties to the Old Colony Trust Company, of Boston, for $4,000,000.

BRIDGEPORT, CT.—The certificate of organization of the Pequonnock Commercial Corporation has been filed in the town clerk's office. The capitalization is given at $150,000. The company will carry on an electrical business.

GADSDEN, ALA.—Captain W. P. Lay, who recently purchased water privileges on Wills Creek, near Attalla, announces that he will erect a plant for the purpose of supplying electric light and power to Gadsden, Attalla and Alabama City.

CARROLLTON, OHIO—A. H. Snively, of Carrollton, and Dr. C. Bolon, of Sherodsville, have been granted a franchise for an electric light plant at Sherodsville. Arrangements have been made whereby they will light the streets of the town.

GRIFFIN, GA.—The Towaliga Falls Company has been organized in this city with a capital of $100,000, with the privilege of increasing it to $300,000. The company proposes to furnish electricity for Griffin and other smaller places in this section of the state.

COLUMBUS, OHIO—The Citizens' Heat, Light and Power Company has been incorporated to operate in Dayton. The capital stock of the company is $10,000, which will shortly be increased. The incorporators are Thomas A. Selz, M. J. Houck, S. Rufus Jones, H. J. Meyers and R. E. Kline.

TROY, N. Y.—It is stated that Bash Bish Falls and many acres surrounding them near Chatham, Columbia County, have been purchased by a New York syndicate which will develop power and transmit same to Great Barrington, Philmont, Chatham and other villages, to operate the street railways in these towns.

WHATCOM, WASH.—It is stated that Mr. Charles H. Baker, the owner of the Snoqualmie Falls Power Company, near Seattle, has become interested in the Stave Lake Power Company, and that a large sum will be spent in putting in a complete electric power plant at Stave Lake, with a view of supplying electric energy to the cities of New Westminster and Vancouver. It is expected that 20,000 horse-power can be developed.

BAKER CITY, ORE.—A syndicate composed of Colonel W. F. Butcher, W. H. Shumaker, J. T. Donnelly, W. H. Gilbert, A. Welch and A. Lenox has purchased the stock and property of the Rock Creek Power Company, a corporation recently organized for the purpose of erecting a power plant on Rock Creek, about twelve miles northwest of this city. The consideration named is $60,000. The plant, when completed, will supply several hundred electrical horse-power, which will be transmitted to this city for light and power purposes.

TELEPHONE AND TELEGRAPH.

COLUMBIA, N. J.—A new telephone line is being built from Columbia to Blairstown, Warren County.

MARINETTE, WIS.—The Wausaukee Telephone Company has been granted a franchise to enter the city.

GREENSBURG, PA.—The Federal Telephone Company has been granted permission to operate in this city.

WINONA, MINN.—The Winona Telephone Company has begun work on a line to extend north of Rollingstone.

READING, PA.—The Pennsylvania Telephone Company is constructing a new line from Reading to Boyerstown.

NEWPORT NEWS, VA.—Extensive improvements will be made to the Citizens' Telephone Company's plant in this city.

MUSCATINE, IOWA—The American Telephone and Telegraph Company is building a line from St. Paul to Davenport.

TRUMANSBURG, N. Y.—The Trumbulls Corners Telephone pany has been incorporated with a capital stock of $2,000.

LIBERTYTOWN, MD.—The Frederick Telephone Company is at work on an extension of its lines from this place to Unionville.

JONESVILLE, N. Y.—Clifton Park Telephone Company. $5,000. Incorporators: Erastus R. Forte, John R. McElroy and Robert Jump.

GREEN BAY, WIS.—The Wisconsin Telephone Company is said to be planning extensive improvements to its Green Bay system.

OXFORD, MISS.—J. W. Clark and F. L. Toale, of Hamilton, Mo., have purchased the Oxford Telephone Company from W. H. Harvey.

CHICKASHA, I. T.—The new telephone system inaugurated by the Topeka & El Reno Telephone Company has been put into service.

DENISON, TEX.—The Southwestern Telegraph and Telephone Company is making extensive improvements to its system in Grayson County.

LANSING, MICH.—Arrangements have been made to connect the Citizens' Telephone Company with the Cooperative Telephone Company, of Detroit.

CONCORD, N. H.—The Citizens' Telephone Company, of Laconia, has notified the Secretary of State of an increase in its capital stock to $160,000.

COOPERSTOWN, N. Y.—Cooperstown, Cherry Valley & Sharon Springs Telegraph Company. $5,000. Incorporators: F. C. Ward, M. D. Eckler and Frederick E. Hopkins.

ALBANY, N. Y.—Colonie Electric Company. $10,000. Incorporators: Henry M. Sage, Menand, N. Y.; John H. Jackson, Menand, N. Y., and Charles W. Little, Albany, N. Y.

INDIANAPOLIS, IND.—The Big Raccoon Telephone Company, which will operate a telephone system in Vigo and Parke counties, has been incorporated with a capital of $4,000.

WORTHINGTON, IND.—The Lyons Cooperative Telephone Company held a meeting and elected the following officers: J. Davidson, Dr. B. F. Chambers and S. N. Yeoman.

DONORA, PA.—The Citizens' Electric Light and Manufacturing Company. $20,000. Directors: R. L. Biddle, G. W. Allen, W. Altman, W. Kirkwood and F. C. Welgus, of Donora.

JANESVILLE, WIS.—A new telephone exchange will be put in by the Western Telephone and Construction Company for the Kenosha Citizens' Telegraph and Telephone Company.

ANSONIA, CT.—The Southern New England Telephone Company has arranged to make many improvements to its system in the vicinity of Ansonia during the late summer and fall.

WARSAW, N. Y.—The Bell Telephone Company is building additional toll lines connecting Warsaw with Wyoming, Pike and Attica, and will also make improvements in its local system.

LEWISTON, ME.—The East Bethel Local Telegraph and Telephone Company has been organized at Bethel for the purpose of carrying on a telegraph and telephone business. The capital of the company is $5,000, and the officers are Z. W. Bartlett and D. W. Colby.

ELECTRICAL SECURITIES.

That there is more inherent strength in many financial institutions than is generally supposed, was proven last week during as sickly a condition of affairs as one might conjure up. With a demoralizing shrinkage in values and several suspensions the total range of Stock Exchange failures only runs up to six. In addition to this, notwithstanding almost a year of depressing values, the July failure returns are encouraging, showing fewer commercial embarrassments and a smaller aggregate of liabilities than in June, and fewer failures than in the same month a year ago. Possibly there may be further disasters during the week, but notwithstanding rumors to this effect and undoubted pessimism in some quarters, there is an evidence of solidity and a faith in the ultimate reversal of the present depression that will be a splendid start from which to launch an upward boom as soon as a favorable opportunity renders this possible.

ELECTRICAL SECURITIES FOR THE WEEK ENDING AUGUST 8.

New York:	*Closing.*
Brooklyn Rapid Transit	39
Consolidated Gas	168
General Electric	150
Kings County Electric	155
Manhattan Elevated	129
Metropolitan Street Railway	108⅞
New York & New Jersey Telephone	161
Westinghouse Manufacturing Company	160

All of the electrical securities suffered declines on the New York Stock Exchange. A raid on Consolidated Gas brought this down 19 points.

Boston:	*Closing.*
American Telephone and Telegraph	131½
Edison Electric Illuminating	225
Massachusetts Electric	82
New England Telephone	120
Western Telephone & Telegraph preferred	82

The Boston market was very dull, and, as is generally the case with downward prices, but little change was manifested.

Gross earnings of the Boston Elevated for July increased $120,000 over July last year, the largest increase in any one month since the present management has been in charge of the road.

Philadelphia:	*Closing.*
Electric Company of America	7¾
Electric Storage Battery common	60
Electric Storage Battery preferred	60
Philadelphia Electric	5½
Union Traction	43
United Gas Improvement	83

The *Wall Street Journal* credits a broker with large interests in the Bell Telephone, of Philadelphia, with saying: "The recent appointment of U. N. Bethel, now president and general manager of the Chesapeake & Potomac Telephone Company and vice-president and general manager of the New York Telephone Company to the additional office of president and general manager of the Bell Telephone Company, of Philadelphia, is an important step in the unification policy of the American Telephone & Telegraph Company. The executive management of the Philadelphia company in reality is not changed, James E. Mitchell, as chairman of the board of directors, remaining the ranking officer. The American company, by this appointment, however, unifies the operating departments of its system in New York, Philadelphia, Baltimore and Washington. Notwithstanding the large increase in the business of the Bell Telephone Company, of Philadelphia, I understand that no increase in the dividend rate is in contemplation. None of the other thirty-five subsidiary companies of the American Telephone and Telegraph Company, according to my information, pays a higher dividend rate, and many of them pay considerably less. The methods of the management are excellent in many respects, but they are open to criticism, I think, in representing to stockholders of the company as scantily as they do the important figures of each year's business. The annual report should be much fuller, I think, in this respect."

Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	142
Metropolitan Elevated preferred	53
National Carbon common	22
National Carbon preferred	91¼
Union Traction common	3½
Union Traction preferred	30

Chicago Telephone fell off 5 points, Chicago Edison losing 6 points, Metropolitan Elevated lost only 1 point, National Carbon common holding strongly at 22, while National Carbon preferred gained 1¼ points. Union Traction common lost 1½ points, Union Traction preferred holding firm at 30.

NEW INCORPORATIONS.

MICAVILLE, N. C.—Estahoe Electric Company. $125,000.

DES MOINES, IOWA—The Otley Telephone Company. $5,000.

GALVESTON, TEX.—The Modern Telephone Company. $300,000.

SCHOOLCRAFT, MICH.—The Citizens' Telephone Company. $5,000.

ZEBULON, GA.—Neal Power and Manufacturing Company. $500,000.

READING, PA.—Trexlertown & Alburtis Street Railway Company. $18,000.

PINE HILL, N. Y.—The Slide Mountain & Pine Hill Telephone Company. $500.

HOMESTEAD, NEB.—Monroe Independent Telephone Company. Increased to $10,000.

GRAFTON, W. VA.—Taylor County Electric Street Railway and Supply Company. $500,000.

ITHACA, N. Y.—The Ithaca Electric Light and Power Company. Reduced from $500,000 to $300,000.

AUSTIN, TEX.—Western Telephone Company. $15,000. Incorporators: C. L. Alderman, R. H. Kemp and P. Pettit.

MADISON, WIS.—Borre Mills Telephone Company. $30,000. Incorporators: G. D. Sprain, W. C. Miller and others.

BEASON, ILL.—The Beason Telephone Company. $2,500. Incorporators: J. T. Gelsthrop, J. E. Bumcrots, G. A. Curry.

GLIDDEN, IOWA—The Glidden Telephone Company. $2,500. Incorporators: J. K. McNaught, C. A. Noble and S. T. Waldron.

BROCKPORT, N. Y.—Brockport Telephone Company. $10,000. Incorporators: F. A. Winne, James Brennan and Thomas H. Dobson.

DENVER, COL.—Trinidad Electric Railroad Company. $300,000. Incorporators: F. P. Read, N. M. Read, P. M. Harlan, G. T. Turner.

ELY, MO.—Union Valley Telephone Company. $3,000. Incorporators: Will Ihrig, Charles W. Schukmaus, Sidney Corder and others.

RIVER FALLS, WIS.—The St. Croix Valley Telephone Company. $1,200. Incorporators: J. L. Chapman, J. A. Chimock and J. Bailey.

FRANKFORT, KY.—The Independence Telephone Company. $5,000. Incorporators: J. M. Chambers, W. T. Loomis, C. M. Petty and J. L. Vest.

LITTLE ROCK, ARK.—Lawrence County Telephone Company. $3,000. Incorporators: F. W. Tucker, W. De Arman, E. J. Mason and C. H. Martin.

LITTLE ROCK, ARK.—The Western Grove Telephone Company. $25,000. Incorporators: H. R. Magness, J. H. Floyd, C. L. Jones and S. R. Crain.

FRANKFORT, KY.—Northern Kentucky Telephone and Tele-

graph Company. $100,000. Incorporators: F. L. Ludlow, M. Durrett and S. P. Kisson.

AUSTIN, TEX.—Lone Star Telegraph Company. $20,000. Incorporators: Harry Huey, J. H. Thrasher, John Camp, C. H. Bayless and Eugene Lamore.

BRIDGEWATER, VA.—North River Electric Company. $10,000. Incorporators: G. Richard Berlin, E. L. Berlin, J. J. Shaver, J. A. Riddel and Edward C. Martz.

MADISON, WIS.—Menomonee & Marinette Light and Traction Company. $560,000. Incorporators: Augustus Spies, Samuel M. Stephenson, John Henes and Gustavus Blesh.

ALBANY, N. Y.—New Paltz, Highland & Poughkeepsie Traction Company. $100,000. Directors: J. A. Duffy and T. G. Huids, Jersey City; G. H. Patterson, Jr., New York city.

LANCASTER, OHIO—The Lancaster, Logan & Nelsonville Traction Company. $10,000. Incorporators: A. Magoon, W. Jones, D. A. Rannells, F. M. McKay and F. E. Pierpont.

ALMA, MICH.—Gratiot County Telephone and Messenger Company. $15,000. Directors: T. W. Whitney, H. Randolph, of St. Louis; W. A. Leet, Ray Maloney, of Ithaca; A. E. Mulholland, Bert Hayes and George Sharrar, of Alma.

INDUSTRIAL ITEMS.

THE WALLACE BARNES COMPANY, Bristol, Ct., manufacturer of small springs of every description and dealer in wire and cold rolled steel, has an elaborate catalogue in preparation. This will be mailed upon issue to any one who may be interested.

EUGENE MUNSELL & COMPANY, New York city, is carrying a large stock of high-grade mica. The Munsell company has options on the best mica producers in the world, and the firm's long experience in this line gives it facilities for quoting on any quantities and in any size.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is enthusiastic over the increasing sales of A B lamps. The company states that in the series alternating arc light system, which is becoming so popular, regulators are furnished in twenty-five, thirty-five and fifty-light capacities.

THE ELECTRIC FLASH LIGHT COMPANY, Denver, Col., manufacturer of incandescent lamps, has placed on the market a flasher that operates without a motor or commutator. A special form of lamp and socket is used and the flashing is done automatically. Circulars will be mailed by the company on request.

THE SWEDISH-AMERICAN TELEPHONE COMPANY, Chicago, Ill., is sending to friends and patrons a unique souvenir in the form of a watch charm receiver. The original supply of these has almost been exhausted owing to the great demand made for them. It is stated, however, that there are a few left, and these will be sent on request.

THE THOMAS E. CLARK WIRELESS TELEGRAPH AND TELEPHONE COMPANY, Detroit, Mich., announces that its apparatus has been installed in the big store of J. L. Hudson, one of the prominent merchants of Detroit. Messages are being sent constantly between two stations for the benefit of customers who are attracted by the novel exhibition.

THE H. W. JOHNS-MANVILLE COMPANY, New York city, has issued a novel folder descriptive of the "Electrotherm," the electrical substitute for the hot water bag. The "Electrotherm" is composed of wires, insulated and protected by asbestos, woven into a light and flexible sheet or pad, which when attached to the ordinary incandescent lamp socket offers sufficient resistance to the current to produce a constant and uniform degree of heat.

THE CORRESPONDENCE INSTITUTE OF AMERICA, Scranton, Pa., has issued an illustrative pamphlet describing the course in electricity as taught in that institution. Instruction is entirely by mail, and covers all branches of theoretical and applied electricity and the subjects necessary as a preparation to take up this course. The editor-in-chief of this course is Professor George F. Sever, of Columbia University, New York, and the chief instructor is Mr. J. Arthur Morgan.

THE WARREN ELECTRIC MANUFACTURING COMPANY, Sandusky, Ohio, is well known for its inductor type of alternating current generator. The company has a reputation also for its advertising literature. A recent bulletin shows some good views of the Warren alternator in several stages of assembly. A graphic illustration is given of the growth of the company since 1894. The analysis shows a remarkable progression, with the possibility of carrying the year line for 1903 beyond the limits of the margin on the bulletin.

H. S. BURROUGHS, New York city, electrical and mechanical engineer, in addition to preparing specifications and reports on lighting and power plants, mill and factory equipments, railway and transmission plants, is representing as sales agent several well-known specialties. Among these are Columbia Electric and Manufacturing Company, enclosed series and multiple arc lamps; Mansfield Engineering Company, high-speed engines and electric cranes; Mutual Electric and Machine Company, knife switches, panelboards and switchboards.

MESSRS. F. BERG & COMPANY'S new hat factory at Orange, N. J., will be run entirely by electricity, an isolated plant now being installed for this purpose. A recent contract with the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., calls for twenty-seven alternating-current, two-phase motors, twenty of which will be belted to shafting to run the machinery used in the process of making hats; the remaining seven are each to be provided with an extended shaft eight inches long and will be direct-connected to blowers used for collecting the fine felt used in the process of manufacture.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, Ill., and Rochester, N. Y., is installing a 200-capacity, generator call, visual signal switchboard at Hart, Mich., for the Oceana Telephone Company. The Stromberg-Carlson company is also installing intercommunicating systems in Chicago, Ill., for the Brunswick-Balke-Collender Company, the Library Bureau, and Brown & Sharpe. A generator call, visual signal switchboard, 140 lines, is being installed for the Citizens' Telephone Company, of Grand Rapids, at Fremont, Mich. The company has recently sold a 300-capacity switchboard together with telephones and a complete equipment to the Rushville Telephone Company, of Rushville, Ill.

A. D. GRANGER COMPANY, agent, 95 Liberty street, New York city, is distributing several fine catalogues descriptive of steel tanks, safety water-tube boilers and Skinner engines respectively. The catalogue describing steel tanks contains illustrations and specifications on circular black steel tanks for gas, air and water, for use as blow-off, receiving, drip, pressure or hot water tanks. The catalogue descriptive of water-tube boilers contains illustrations and specifications on "Star" safety water-tube boilers for power, steam heating and hot-water heating. The engine catalogue is very handsomely made up. This contains a number of splendid half-tone reproductions of Skinner engine with automatic systems of lubrication, built by the Skinner Engine Company, Erie, Pa. Any or all of these catalogues will be sent on application.

THE PETERBOROUGH HYDRAULIC POWER COMPANY, of which Senator George A. Cox is president, is building a new power plant on the Otonabee River in the town of Peterborough, Ontario, Canada, which will be equipped with the following apparatus recently purchased from the Westinghouse Electric and Manufacturing Company: A 1,500-kilowatt, 2,240-volt generator, having 7,200 alternations and running at 150 revolutions per minute, to be direct-connected to water-wheels; also two 125-volt, direct-current, direct-coupled to exciters of seventy-five kilowatts capacity each, together with switchboard consisting of a large generator panel and two exciter panels. The power-house, when completed, will be an unusually fine one and is to furnish power to the Peterborough mill of the American Cereal Company, owned by the Quaker Oats Company; power will be supplied to several other manufacturing plants in the town, and also to the Peterborough Light and Power Company, which does the electric lighting and small power business in Peterborough.